

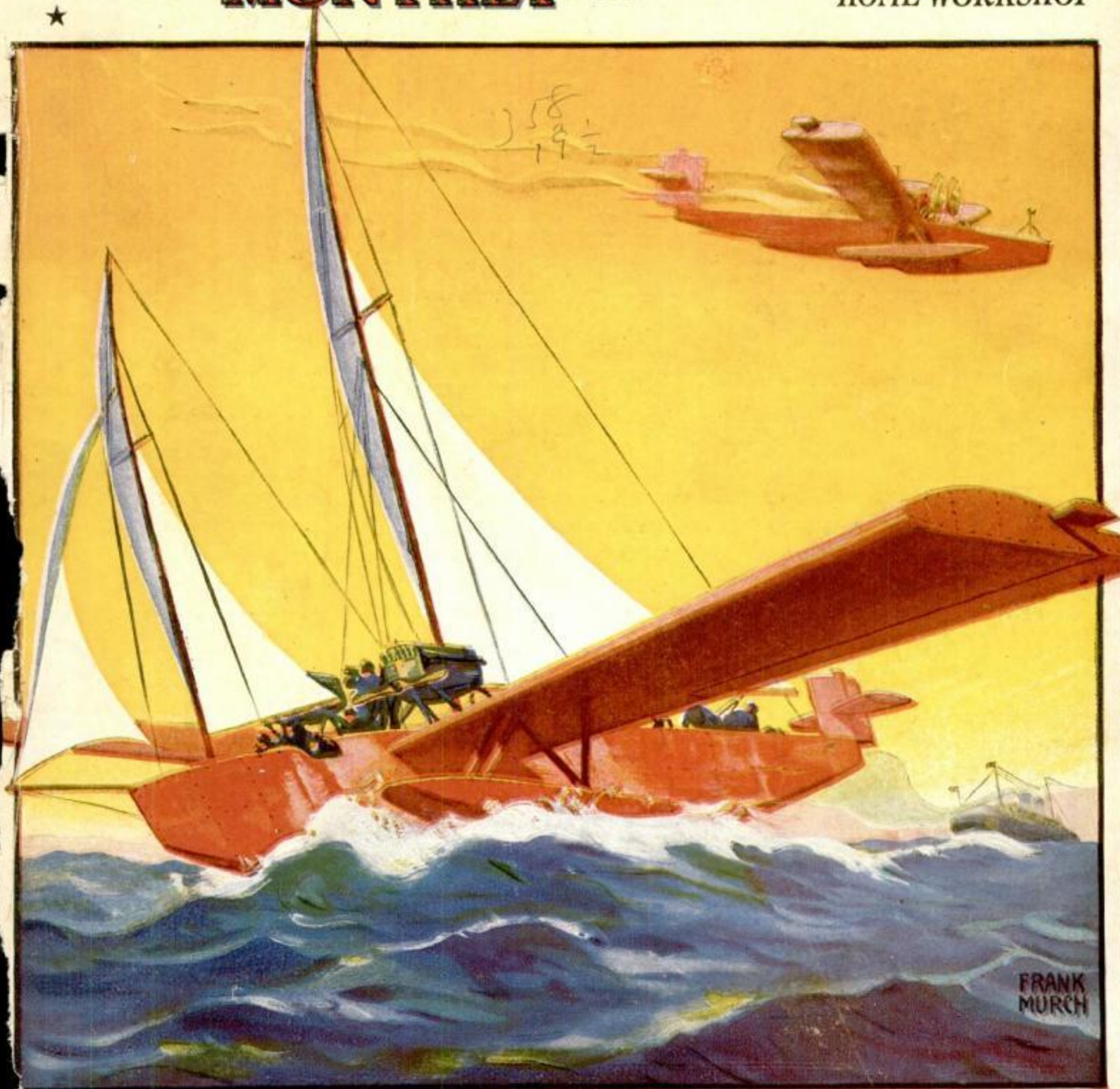
\$10,000 Prize Contest - See Page 29

Popular Science

FOUNDED

MONTHLY 1872

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP



AUGUST

Flying Sailboat—the Newest Marvel of the Air

25 CENTS

Copyrighted material



UV-201-A

UV-200

UV-199

WD-11

WD-12



Vital to every radio fan

In a radio set, it is the tube that detects the sound—that amplifies the sound—that determines in large part the quality and volume of the sound. Therefore the tube—intricate of mechanism and delicate to make—is the vital spot in every set. And it always pays to be sure you use genuine Radiotrons—made with experienced precision.

Build any circuit—simple or complex. Buy any set, plain or fancy, simply boxed or elaborately cabined. But give it every chance to achieve its best—with genuine Radiotrons. Be just as careful when you replace tubes, too. *Always* see for yourself that each one bears the identifying marks of a Radiotron: The word Radiotron and the RCA mark.

Radio Corporation of America

Chicago

New York

San Francisco

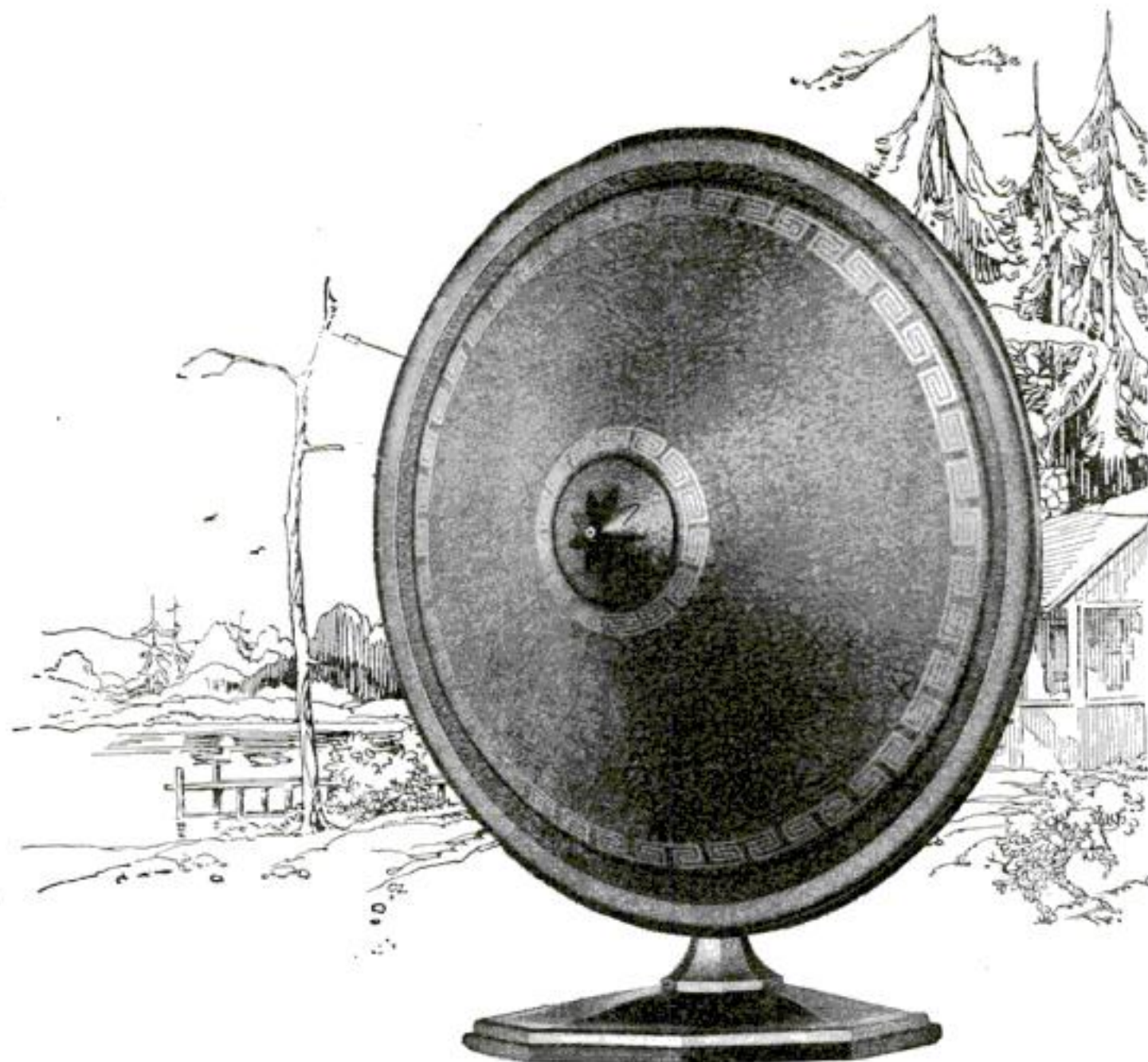


Radiotron

REG. U.S. PAT. OFF.

PRODUCED ONLY BY RCA





The Crosley Musicone

a startling improvement in looks and tone over loud-speakers
Already replacing thousands

In camp or home, this remarkable development of radio reproduction will greatly increase your delight in radio.

It is a new idea. It diffuses the sound. Upon hearing it for the first time one is at loss to locate the source of the music. Its perfection of reproduction is uncannily real.

Its price, like all Crosley products, is very low because of the half-million production plans under which it is being built. Hear it at all Crosley dealers now.

Crosley owns and operates station WLW, Cincinnati, the first remotely controlled super-power broadcasting station.

Crosley manufactures receiving sets which are licensed under Armstrong U. S. Patent No. 1,113,149, and priced from \$14.50 to \$65, without accessories.



The Crosley Radio Corporation

Paul Crosley, Jr., President

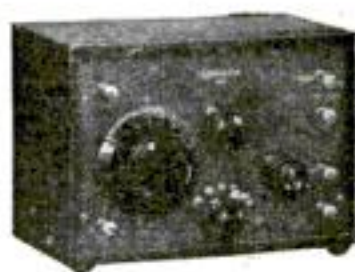
817 Sassafras Street, Cincinnati

\$17⁵⁰

Add 10% West of Rocky Mountains

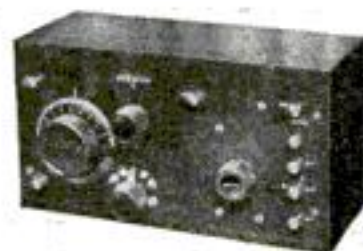
CROSLEY
Better~Costs Less

The Marvels of Radio!
Incredible to those who don't know!



The Crosley 1-Tube 50

Crosley's development of the famous Armstrong regenerative circuit enables you to "roam" the country and enjoy the thrill of picking up distant stations just as though you owned a multi-tube set,—all with one tube and at \$14.50, without accessories.



2-Tube Crosley 51

Same as wonderful Crosley 50 with additional tube amplifier. Local and nearby stations on loud-speaker always and distance up to 1500 miles under average conditions. Much greater range with head phones. \$18.50, without accessories.



3-Tube Crosley 52

A larger set for those who want greater reception range on the loud-speaker. Operates on three tubes, using wet or dry batteries. Consistent loud-speaker range 1500 miles or more. \$30, without accessories.



The Crosley Trirdyn Special

3-Tubes do the work of 5

A unique circuit combining tuned radio frequency, regeneration and reflexed amplification that equals in results the work of 5 and 6 tubes. None re-radiating. \$65 without accessories.

Popular Science Monthly

The Magazine of Invention and Discovery

AUGUST, 1925; Vol. 107, No. 2

25 cents a Copy; \$2.50 a Year



Published in New York City at
250 Fourth Avenue

Coming Next Month

Wild Beasts at Close Range—How a daring big-game hunter made astonishing flashlight photographs of wild animals in the jungle. You won't want to miss these thrilling pictures in next month's issue.

Secrets of Successful Gear-Shifting—Another of Martin Bunn's fascinating "Gus and Joe" stories, in which Gus, the mechanic of the "Model Garage," explains valuable little tricks of gear-shifting that will help you get the most satisfaction out of driving.

A New Aid for Aviators—The story of a remarkable new instrument that enables airplane pilots to determine exactly the deviation of their craft from the laid-out course of flight as the result of side winds.

The Fourth Set of \$10,000 Contest Pictures—You still have plenty of chance to win one or more of the big cash prizes in our remarkable \$10,000 "What's Wrong" Contest. The July Contest is still open for entry; the August Contest appears on pages 29, 30, and 31 of this issue; and the September contest will be published next month. And, in addition, you still have as good a chance as anybody in the Grand Prize Contest. Turn to page 29 of this issue and read about it.

More than 200 other fascinating articles and pictures, giving you all the news of radio and engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

Commander Le Prieur of the French Army Aviation Service, with his invention known as the "navigraph," which tells airplane pilots the deviation of their craft from the laid-out course of flight, due to side winds



POPULAR SCIENCE MONTHLY

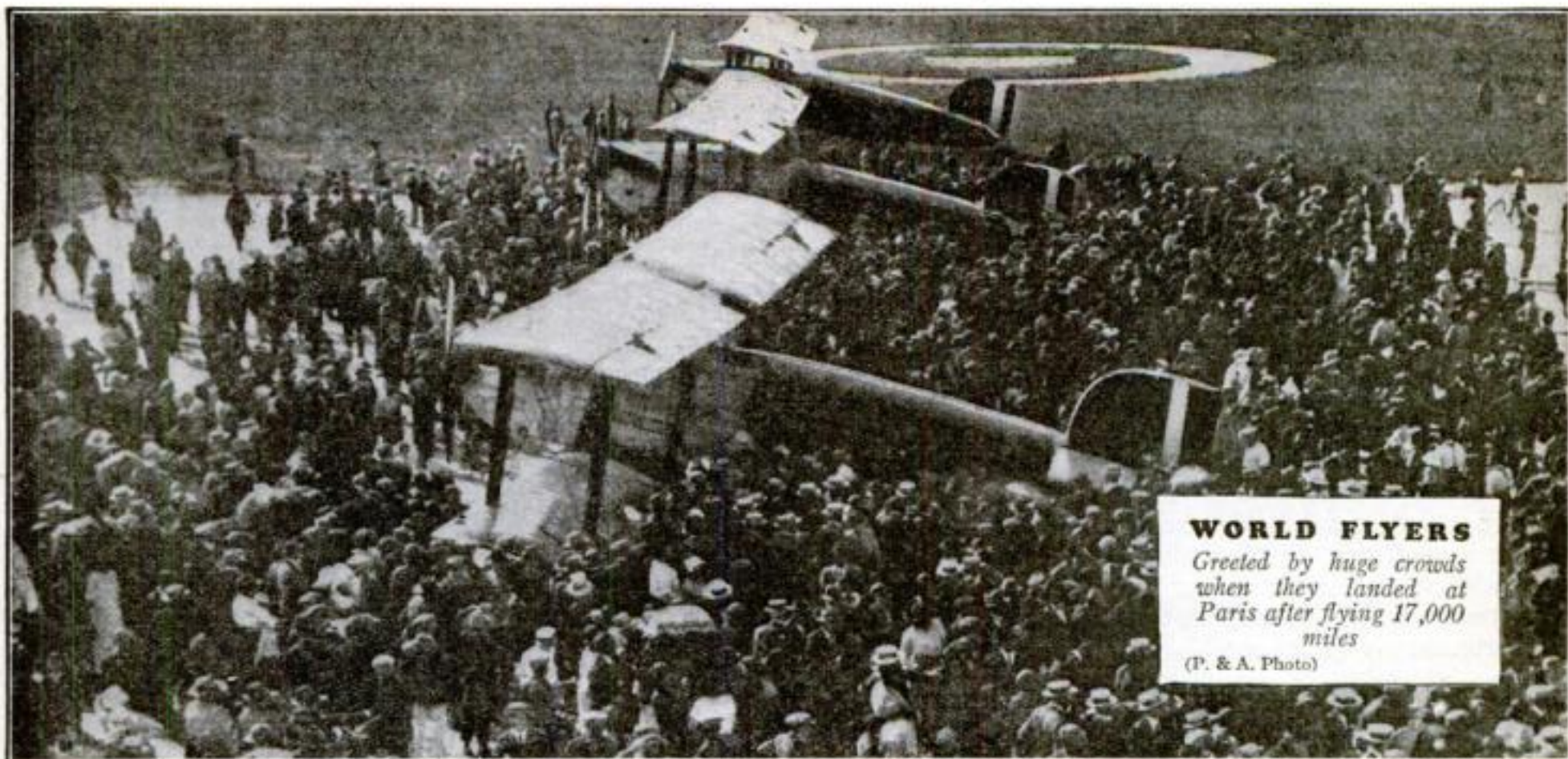
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O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

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And Other Timely Articles and Pictures

**WORLD FLYERS**

Greeted by huge crowds
when they landed at
Paris after flying 17,000
miles

(P. & A. Photo)

Daring Young Men Needed in Aviation

Aviation in America is on the threshold of an amazing new development. The prediction of pioneers is now an actuality—for in the past few months the newspapers have announced the establishment of gigantic commercial air lines. The biggest capital and business forces in the world are behind this enterprise. And now, even in the beginning, thousands of young men are needed. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

THERE is no field of work in the world today which offers such amazing opportunities to young men of daring and who love adventure as does Aviation. Although still in its infancy, there is a crying demand in Aviation for young men with courage, nerve and self reliance. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

Big Opportunities Await the Trained Man

Look over the fields of work which are open to the young man today. You will find that Aviation is the **ONE FIELD** that is not overcrowded—the **ONE FIELD** in which there is plenty of room at the top. Think of it! Only 21 years ago Orville and Wilbur Wright made the world's first airplane flight. Now airplanes

fly around the world. Yes, Aviation offers the same wonderful opportunities today that the automobile and motion picture industries did 15 and

20 years ago. Men who got in on the ground floor of those industries made fortunes before others woke up. **AVIATION IS NEW!** It clamors for nervy young men—and the trained man has the world before him in Aviation.

Easy to Become an Aviation Ex- pert—\$50 to \$100 a Week

You can qualify now quickly for one of these exciting highly paid jobs

through a new, sure, easy method of training. The study of Aviation is almost as interesting as the work itself. Every lesson is fascinating and packed full of interest. That's why Aviation is so easy to learn—you don't have to force yourself to study—once you start, you can't get enough of it. Only one hour of spare time a day will give you the basic training in an amazingly short time.

PREPARE For One of These POSITIONS

Aeronautical Instructor
\$60 to \$150 per week
Aeronautical Engineer
\$100 to \$300 per week
Aeronautical Contractor
Enormous Profits
Aeroplane Repairman
\$60 to \$75 per week
Aeroplane Mechanician
\$40 to \$60 per week
Aeroplane Inspector
\$50 to \$70 per week
Aeroplane Salesman
\$5000 per year and up
Aeroplane Assembler
\$40 to \$65 per week
Aeroplane Builder
\$75 to \$200 per week

One student, S. F. McNaughton, Chicago, says: "Your lessons are like a romance, and what is more, after one reading, the student gets a thorough understanding. One never tires of reading them." James Powers, Pa., another student says: "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Personal Instruction By Experienced Men

Men who have had actual experience in Aviation give you personal attention and guide you carefully through your training. They select the lessons, lectures, blueprints and bulletins. They tell you the things that are essential to your success. Every lesson is easy to read and quickly understood.

Big Book on Aviation FREE

Send coupon below for New Free Book, just out, "Opportunities in the Airplane Industry." It is interesting and instructive and will show you many things about Aviation which you never knew before. Only a limited number offered—get yours before the edition is exhausted.

American School of Aviation
Dept. 136-C
3601 Michigan Ave., Chicago, Ill.



AMERICAN SCHOOL OF AVIATION,
3601 Michigan Ave., Dept. 136-C, Chicago, Ill.

Without any obligation, send me your Free Book, "Opportunities in the Airplane Industry," also information about your Course in Practical Aeronautics.

Name.....
Street.....
City.....State.....

CHRISTIANITY ON BROADWAY

Excerpts from editorial in
The Daily Reporter, White Plains, N.Y.
By W. Livingston Larned

AN unusual project has been set in motion in New York. A "Business Building" is to rise on Broadway, at 173rd Street, dedicated to Christianity. To be known as the "Broadway Temple," it will contain a church, offices, auditoriums, schools, hotel accommodations, cafeterias, etc. And to a large extent, it will be erected by popular subscription. Individuals buy bonds, representing a 5 per cent investment and the total cost will be approximately \$4,000,000.

It is the first undertaking of its kind, and has so many amazing features that we will do well to observe some of these innovations. For this is a combination of church and skyscraper. Business and Christianity will be housed under one roof.

This Broadway Temple is, in a sense, a gigantic symbol of the uncontrovertible fact that Godliness can and should be continuous.

Broadway will be the better for a substantial reminder of this Holy Presence. From every vantage point, on sunny days, or nights filled with the sinister menace of storm, a high-flung cross of unquenchable light will be visible, glittering against the heavens. And he will murmur to himself reverently, "The Holy Spirit bides with me wherever I may be, walking or sleeping."

Broadway Temple will cover 26,000 square feet of foundation space, facing a whole block on Broadway. It will have a beautiful tower, 24 stories high; six million people will see a revolving cross of light, 34 feet high, on its topmost pinnacle. The church auditorium will seat 2200; there will be Sunday school rooms, a social hall and every modern convenience for religious and community work. An apartment hotel in the tower is to contain 644 rooms, public offices and dining halls. Apartments for housekeeping in the two wings will accommodate 500 persons. And there are stores fronting on Broadway.

In exploiting this magnificent and ambitious plan, its sponsors say: "A 5 per cent investment in your Fellow Man's Salvation, Broadway Temple is to be a combination of Church and Skyscraper, Religion and Revenue, Salvation and 5 per cent—and the 5 per cent is based on ethical Christian grounds."

Broadway Temple is more than a revolutionary idea, more than a sound investment, more than an architectural wonder of the age; it represents a spiritual stepping stone in man's climb upward to the Cross.

**"Buy These Bonds
and Let God
Come to Broadway"**

Religion and Revenue Glorified by a Wonderful Ideal

The Directors who will conduct this business enterprise, the men with whom you, as an investor, will be associated, are some of the keenest and best-known business men in New York. They are

President: Ellis L. Phillips,
Pres. Long Island Lighting Co.
Arthur J. Baldwin, Vice-President
McGraw Hill Publishing Co.
Carl H. Fowler, Vice-President,
Fowler & Holloway
Samuel McRoberts, Treasurer,
Chatham & Phoenix Nat'l
Bank & Trust Co.
W. R. Comfort, President,
Reid Ice Cream Co.
Charles A. Frueauff,
Frueauff, Robinson & Sloan
Frank De K. Huyler,
President of Huyler's
E. V. P. Ritter,
Formerly Pres. Grand Central
Palace
M. G. Collins, Vice-Pres., Broker
Watson S. Moore, Vice-President,
Formerly V.P.U.S. Grain Corp.
Frederick Kraft, Secretary,
Kraft Cheese Co.
Hon. Royal S. Copeland,
U. S. Senator
Lamar Hardy,
Former Corporation Counsel
Robert H. Montgomery,
Lybrand, Ross Bros. & Mont-
gomery
W. P. Tanner,
W. P. Tanner-Gross Co.



BROADWAY TEMPLE
A Twentieth Century Cathedral, Church,
Hotel, Stores, Apartment House;
Self-Supporting, Community-Serving

Why this is a SAFE Investment

Merely as an investment the Bonds of the Broadway Temple are inviting as a business proposition. Ewing, Bacon & Henry, real estate experts, in a letter to Donn Barber, the architect, set forth the following conservative estimate of income:

Rental from stores	\$27,500
Income from two apartment houses	166,290
Income from apartment hotel	402,300

Total annual income . . . \$596,090

Total expenses and interest and taxes . . . 470,500

Leaving a net surplus for the bond holders of \$125,590 annually

General Samuel McRoberts, Treasurer,
Broadway Temple Building Corporation,
149 Broadway, New York, N. Y.

Without obligation to me, please let me know about the BROADWAY TEMPLE Bonds.

Name.....

Street.....

City..... State.....

Or if you desire, fill out the following subscription:—I hereby subscribe for \$..... par value Second Mortgage Broadway Temple 5% Cumulative Interest Bearing Bonds, and agree to make payments as follows:

(a) I enclose check for total amount of subscription.
(b) I will pay 10% of my subscription on the first day of the month following the date of this pledge, and 10% every sixty days thereafter until full amount of subscription is paid.

Signed.....

Address..... City and State.....

P. S. John D. Rockefeller, Jr., has agreed to take the last \$250,000 of the Bonds.

What Electricity and Cooke Training Have Done for Me

By S. D. RISIO

President, the Modern Electric Co., Newburgh, N. Y.



TWO years ago I was working at odd jobs, at small pay, without much future ahead of me. To-day, I am my own boss, the head of a prosperous electrical company in a busy city of 35,000 people.

Two years ago I was just a laborer—untrained and hence not able to do more than work with my hands. To-day I am a trained Electrical Expert, making three times as much money as I formerly did.

Two years ago I was a failure. To-day I am a success.

And I owe that Success to two things—Electricity and Cooke Training. Electricity offered me the opportunity; L. L. Cooke trained me and showed me how to make the most of that opportunity.

Yet I knew nothing about Electricity when I started.

I had been in America only two years when I enrolled for home-study training in Electricity with L. L. Cooke, Chief Engineer of the Chicago Engineering Works. I knew nothing about Electricity, but I did know that it held wonderful opportunities for the trained man.

Although I had gone only to the fifth grade in school, and had been

working in the fields ever since, doing almost no reading or studying, I found Mr. Cooke's lessons were easy to understand. I got busy on them right away and in three months had finished about half of his Course.

Then I decided to make the big jump—give up my job and go into business for myself as an Electrical Contractor. It was a real test for the Cooke Course, because I had learned all I knew about Electricity from it, and if it wasn't right I couldn't have succeeded in business. But the lessons were right—100% correct on everything. So I began to get electrical jobs and soon I was wiring houses for Electricity. Every customer liked my work and said it was well done.

My business has been growing all the time. Recently I completed a big wiring job on which I made over \$300 profit for myself. I have opened up a big Electrical Supply Store and repair shop in connection with my contracting work, and make good money on the side selling electric light fixtures, lamps, vacuum cleaners, flat-irons, etc. I have several men working for me and always have more work than my company can handle.

Mr. Cooke has been like a friend and partner to me, as well as a teacher. He encouraged me to keep trying, when, if I had listened to the advice of others, I would have been tempted to quit, and he has worked on my problems and helped me and

gave me good advice every step of the way.

His training paid for itself in less than four months after I enrolled through profits I made on Electrical Jobs. But I am still benefiting from his Course and will be as long as I live. He did not forget me when I had paid in full for his Course, but kept right on giving me help and service.

So my advice to any man who wants to be a success, and who is not satisfied with his present job, is "FIND OUT WHAT L. L. COOKE CAN DO FOR YOU—FIND OUT ABOUT THE OPPORTUNITIES

IN ELECTRICITY—AND THE ROAD TO BIG PAY WILL OPEN UP BEFORE YOU."

Mr. Cooke has published a big illustrated book called "The Vital Facts about Electricity" which he will send free on request. Just address, L. L. Cooke, Chief Engineer, Chicago Engineering Works, Inc., Dept. 3-C, 2150 Lawrence Ave., Chicago, Ill., and he'll send you this book and tell you all about Cooke Training. Send the Coupon to-day!

"He Made Me a Real Electrical Expert"



This is L. L. Cooke, Chief Engineer of the Chicago Engineering Works, the man who has enabled hundreds and hundreds of men to make \$3,500 to \$10,000 a year in the Big Pay Field of Electricity.



L. L. COOKE, Chief Engineer,
Chicago Engineering Works,
Dept. 3-C, 2150 Lawrence Ave.,
Chicago

Send me your book "The Vital Facts About Electricity," full particulars of your Home Study Course, and your 16 Big Offers including your plan for helping me earn extra money while learning. This does not obligate me to enroll for your Course.

Name

Address

City

State

Money Making Opportunities for "Popular Science" Readers



ADVERTISING SERVICES

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

24 WORD ad 355 rural weeklies, \$14.20. Ad-Meyer, 4112P Hartford, St. Louis.

CIRCULARIZE guaranteed lists. Agents' names, \$5.00, 1,000. Pennell, Covington, Ky.

COMBINATION Winner. 125 Magazines, 10c word, \$8.00 inch. Thrice, Interstate Advertiser, Munster, Mich.

I WRITE booklets, folders, letters, complete follow-up for manufacturers, Mail order dealers. Long experience. Write for prices. L. Taylor, Box 844, Freeport, Ill.

AMERICAN MADE TOYS AND NOVELTIES

OPPORTUNITY to start Manufacturing Metal Toys and Novelties. No experience necessary. Enormous demand exceeds supply. We furnish, at cost, casting forms for production and buy entire output, also place yearly contract orders. Casting forms made to order. Catalog, advice and information free. Metal Cast Products Co., 1696 Boston Road, New York.

AUTHORS AND MANUSCRIPTS

PHOTOPLAY—Story Ideas wanted. \$25-\$500 paid. Experience unnecessary; outline Free to anyone. Write Producers League, 312 St. Louis.

WRITERS—Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

\$\$\$ FOR Ideas. Photoplay plots accepted any form, revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

I WANT song poems. Casper Nathan, J-3544 No. Racine, Chicago.

SONG Poem Writers send for proposition. Ray Hibbeler, D10, 4040 Dickens Av., Chicago.

SHORT Stories, Articles, etc., typewritten and marketed. Hursh Service, Dept. 3, Box 1013, Harrisburg, Penna.

AUTOMOBILES AND ACCESSORIES

HOW to rewind Ford armatures, \$1.00. Kelsie Click, Mt. Vernon, Ohio.

44 MILES on 1 gallon—Wonderful Vapor Humidifier for autos. 1 free to introduce. Critchlow, PS-C 120, Wheaton, Ill.

DELIVERY Bodies for Ford Model T. Chassis with enclosed cab, suitable for contractors, grocers and farmers, three styles. Price \$37.50. Write Daniel Zimmerman, Craigville, Indiana.

THE SUPERBA polishes shoes, brass, etc., grinds valves, removes carbon, drills, polishes, saves time, money, effort, complaint. Send for circular. Sirianni & Trumbetta Mfg. Co., 6 Brown St., Carbondale, Pa.

AVIATION

The American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan, Ave., Chicago, Illinois.

BOYS fly this three-foot model aeroplane. Small cost. Write for circulars. Aero Shop, 3050 Hurbit Ave., Detroit, Mich.

GREATEST Glider Airplane. Flies 300 feet. Prepaid 35c. Big model catalog 5c. W. H. Phipps, 578 Kaleckerbocker Ave., Brooklyn, N. Y.

AIRPLANE turnbuckles, new, very useful for truing-up sagging doors or gates and radio wires send 25c for two samples postpaid. Write for our sales bulletin it's free. Johnson Airplane Supply Co., Dayton, Ohio.

WANTED Airplane Pilots and Mechanics. We have calls for a number of experienced airplane pilots and mechanics also a limited number of apprentice helpers who are willing to work for flying training. No fees charged. All applicants are requested to be subscribers to Slipstream Aviation Monthly, The Commercial Flyers' Magazine, at \$2.00 per year. Send application with subscription now, stating experience and if temporary work will be accepted. Slipstream Publishing Company, Dayton, Ohio.

BOATS AND LAUNCHES

BOATS that always go are propelled by Ford engines. Ford dope free to boat owners. Harry Rider, East Norwalk, Conn.

BUSINESS OPPORTUNITIES

TEN 2 cent stamps brings Free Particulars. Desk B. Surety Service Company, 551 Harvard St., Rochester, N. Y.

START a Business of Your Own. 97c. profit out of every \$1. Opportunity of a lifetime. Success guaranteed. Articles cost less than 1c each, sell for \$1. Send 25c and I will send you complete plans and enough material to bring you \$20 when sold. Theodore W. Messick, Dept. 14MC, 1136 South Seventh St., Camden, N. J.

FREE Book. Start little mail order business. Pier, 976 Cortland Street, N. Y.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making \$3000 to \$10,000 yearly, easy terms for training by mail, no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

EVERYBODY needs and buys the "Business Guide." Wells cleared \$1,150 in 35 days. Send for sample. It's Free. Nichols Co., Dept. 1B, Naperville, Ill.

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What Advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize \$10.00
Second Prize 5.00
Third Prize 3.00
And 7 Prizes
of \$1.00 each 7.00

First read every one of the "Money Making Opportunities" advertisements on pages 6 to 15. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, not more than seventy words, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before Aug. 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the Oct. issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Last Month's Prize Winners

The first prize of \$10.00 goes to Mr. J. E. Baucom, of Wilson, Oklahoma for his letter on the advertisement of Walter McDonnell. Here is Mr. Baucom's letter:

Dear Sir:

I looked over the various advertisements in Money Making Opportunities and that of Walter McDonnell, 59 Potomac Bank Building, Wash. D. C. interested me most, because he offered just what I was looking for a cure for stuttering and stammering of which I was a victim. I secured the treatment at a nominal cost and to my surprise, in just a few days, I was greatly improved. Today I talk clearly.

Yours truly,

J. E. Baucom.

Mr. W. P. Chapman, of Whigham, Ga. wins the second prize for the following letter on the advertisement of the John Rahn of Chicago, Ill.

Dear Sirs:

I have been interested in sign painting for a long time, but the companies whose advertisements I answered failed to give satisfaction. I answered the ad of John Rahn, Chicago, which was in the Popular Science and the results were splendid. I now have a very profitable business in sign painting. All advertisers in Popular Science are reliable.

Yours very truly,

W. P. Chapman.

The Third Prize goes to Edward Russell, Pittsburgh, Pa., for his letter on the advertisement of the Handy Dental Specialty Company.

The winners of the other seven prizes are:

S. W. Stanbery, Winona, Idaho; Frank G. Davis, Harrisonburg, Va.; Soichi Nakagawa Kealia, Kauai, Hawaii; Leila Livermore, Memphis, Tenn.; Burton Gilson, Brinston, Ont.; Mrs. T. H. Lynn, Hyattsville, Maryland; W. F. Sandmann, Indianapolis, Ind.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Oct. issue should be received by August 5th

BUSINESS OPPORTUNITIES

SOMETHING new in the Mail Order Business. Starts you in business right at home. No part time, or house to house methods. Station A, Box No. 6, San Diego, California. H. N. Allison.

INCH Display Advertisement, 166 Magazines, year, \$50.00. Woods Popular Service, Atlantic City.

PATENTS procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington D. C., or 41-Z Park Row, New York.

SIGNS and Showcards easily painted with Letter Patterns. Large variety of styles and sizes. Sample for stamp. John Rahn, G2433 Greenview Ave., Chicago.

USED Correspondence courses of all schools sold, rented and exchanged. List free. (Courses bought.) Lee, Mountain, East Chattanooga, Tenn.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

START small home Mail Order Business. Booklet 2c. Harvey Teeple, Decatur, Indiana.

THE Great Wheat Secret. New book showing the cause of wheat swings and how to forecast them. Unequaled method for traders, speculators, millers. Eye-opening folder free; write today. Market Forecaster Co., Dept. B., Box 174, Topeka, Kansas.

WE start you in business, furnishing everything; men and women, \$80.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

GOLD, Silver, and colored Sign Letters for windows, automobiles, trucks. Make them yourself with our Process and Letter Patterns. Fast sellers. Big profits. No experience. Stamp brings actual sample. Wilterding, 1144 Pleasant Street, Oak Park, Illinois.

ARE you old at forty? See our advertisement on page 117 of this issue. The Electro Thermal Company, 4048 Main Street, Steubenville, Ohio.

LEARN privilege trading, remunerative returns, \$75 up sufficient. Write Dept. R, Paul Kaye, 149 Broadway, New York.

LEARN how to solder all kinds of metals. Send 50c coin and address of three friends for this copyright book. "Twenty Years of Soldering Experience." Tinner, Box 1134 Scottsbluff, Nebraska.

IMPORT your own goods. Big German export magazine published in English offers thousands of bargains in latest novelties. Sample copy 50c. Opportunity for obtaining profitable agencies. L. Abbe Specialty Co., 263 Fifth Ave., New York City.

44 MILES on 1 gallon—Wonderful Vapor Humidifier for autos. 1 free to introduce. Critchlow, PS-E 120, Wheaton, Ill.

GET into line with Gilbert's House Wives' necessities, good profits easy sellers, Six Samples \$1.00. Gilbert Sale Co., Box 26-K, Milford, Conn.

GLASSCOAT elastic paint made at home for twenty cents and sells for \$1.00 per gallon. Directions \$1.00. Glasscoat Products Co., Clinton, Indiana.

SUCCEED With Your Own Products—Formulas. Processes. Trade-Secrets. Modern master methods. Catalog free. C. Thaxley Co., Washington, D. C.

MIRRORS re-silvered at home. Costs less than 5 cents per square foot; you charge 75 cents. Immense profits, plating autops, reflectors, tableware, stoves. Refinishing metalware, etc. Outfits furnished. Write for information. Sprinkle, Plater 94, Marion, Indiana.

FREE Booklet describes 52 plans for making \$20.00 to \$100.00 weekly in home or office business of your own. Downs Co., 2326 Myrtle, St. Paul, Minn.

BUSINESS SERVICES

CHARTERS—Delaware; best, cheapest; granted day received; free forms. Colonial Charter Co., Wilmington, Del. (99)

CHALK TALKS

LAUGH producing program, \$1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

WORLD'S fastest selling auto accessory! County distributors wanted; write to-day. G. L. W., Spring Oiler Co., San Diego, California.

REPRESENTATIVE wanted for this territory. Wonderful value Men's, Women's, Children's shoes direct, saving wearer over 40%. 72 styles. Experience unnecessary. Permanent steadily increasing income. Write today—Tanners Shoe Mfg. Co., 7-412 C St., Boston, Mass.

AGENTS: Five to Fifteen Dollars daily in advance. Twenty Dollar Sample outfit FREE to workers; no delivering. B. & G. Rubber Mfg. Co., Dept. 784, Pittsburgh, Penna.

DISTRICT salesman for union made, hand tailored, all wool suits and overcoats at \$23.50. Prefer married man with sales experience. \$35.00 weekly to start. Apply D. N. Harvey, Box 90, Chicago.

**More Money Making Opportunities
on pages 8 to 15**

Are You Really Well Informed?

Test Yourself with this Famous Questionnaire!

EVERYBODY is talking about the famous "Popular Science Questionnaire." In the panel is the list of questions of which the Questionnaire is composed. How many of them can you answer?

These questions were prepared, after a great deal of thought, by a group of eminent scientists. Their test has become famous throughout the country as the "Popular Science Questionnaire."

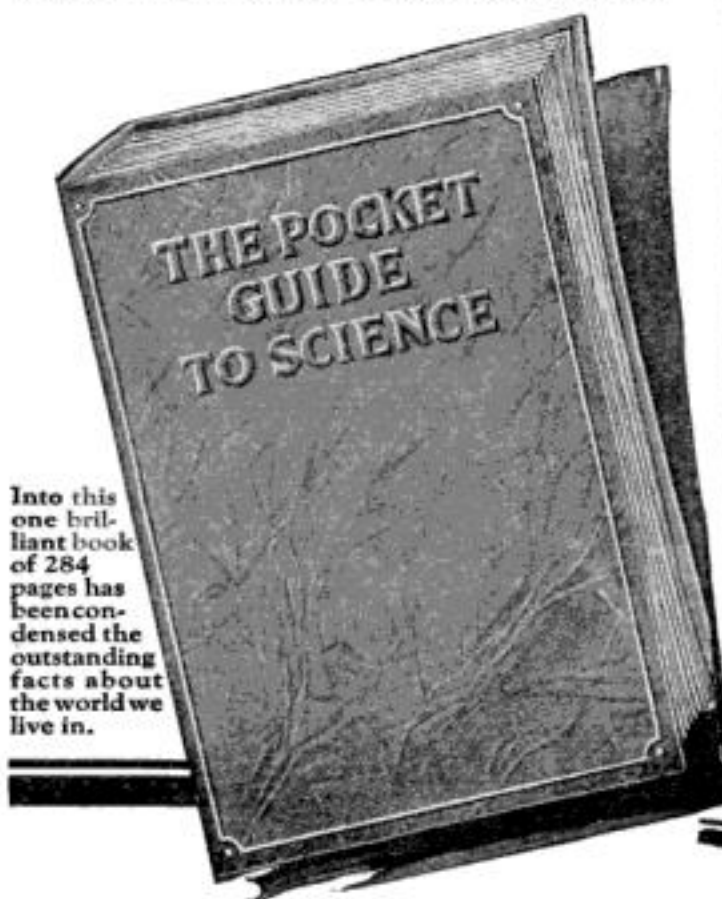
Like an Old-fashioned Examination

May we ask you to make this test carefully, reading the questions slowly and giving thought to each one? When you cannot answer one satisfactorily to yourself, put a zero (0) beside it.

On the other hand, give yourself credit of four (4) for each satisfactory answer. Then when you are through, see how near you have come to making a mark of 100.

This is like an old-fashioned examination, but you will find it fascinating. The questions all have to do with the wonders of the world we live in. All can be given quick and straightforward answers by any person of education.

All of the questions in the famous "Popular Science Questionnaire" and many hundreds of others, have now been answered, for the first time, in one book—THE POCKET GUIDE TO SCIENCE.



Into this one brilliant book of 284 pages has been condensed the outstanding facts about the world we live in.

All that you probably ever will want to know about science is told in this one 284-page book that will fit in your pocket or grace a library table. Curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

You are assured of the accuracy of the answers in THE POCKET

GUIDE TO SCIENCE because it has been edited by Dr. E. E. Free, who has remarkable genius for condensing the known facts about scientific questions into easily remembered paragraphs.

Free

THE POCKET GUIDE TO SCIENCE is not for sale. It is offered to you absolutely free with a 14 months' subscription to POPULAR SCIENCE MONTHLY.

POPULAR SCIENCE MONTHLY "carries on" from where THE POCKET GUIDE TO SCIENCE leaves off. THE POCKET GUIDE gives you all that the scientists have discovered up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

It takes over 300 articles and pictures every month to tell the readers of POPULAR SCIENCE MONTHLY all that has happened in the scientific, radio, mechanical and automotive fields.

Your Name in Gold

THE POCKET GUIDE TO SCIENCE is bound in beautiful flexible fabrikoid. We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE at no extra cost to you if you use the coupon below immediately.

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Send No Money

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular, you may return them, and your entire payment will be refunded promptly and without question. Could any offer be fairer?

POPULAR SCIENCE MONTHLY P. S. M. 8-25
250 Fourth Avenue, New York

I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman \$2.95, plus the few cents' postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold.

Name.....

Address.....

City..... State.....

The POPULAR SCIENCE QUESTIONNAIRE

Test Yourself Now

1. Why does radium continue to give out heat for thousands of years?.....
2. Are the stars solid like the earth?.....
3. How was the earth formed?.....
4. Why is glass transparent?.....
5. How do we know that the earth is slowly shrinking?.....
6. What is an electric current?.....
7. How was petroleum formed?.....
8. Do electrons really move through wire when an electric current is flowing through it?.....
9. What physical changes in your body are produced by fear?.....
10. How do muscles exert power?.....
11. What are X-rays?.....
12. Can we see atoms with a microscope?.....
13. Why does heat expand things and cold contract them?.....
14. Why does the moon appear to change its shape from time to time?.....
15. What is the brain made of?.....
16. Why is it possible that the inside of the earth is growing hotter instead of colder?.....
17. Why is frost more likely on a clear night than on a cloudy one?.....
18. Does thinking use up the thinker's energy?.....
19. Which travels faster, electricity or light?.....
20. What simple test will distinguish wool from cotton?.....
21. What makes the noise of thunder?.....
22. Why would men ultimately suffocate if all the green plants were killed?.....
23. Does the boiling of water remove the impurities in it?.....
24. How do the living cells of the body get the energy with which to do their work?.....
25. How is the speed of light measured?.....

TOTAL PERCENTAGE.....

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Don't sell your time for low wages! You don't need to with Cooke "Job-Way" Training. Get my Free Book. Find out how you can be a Big Pay Man. MASTER every Branch of Auto Work right in your own home. See how I train you quickly and easily to BOSS the job or go into business where up to \$10,000 a year can easily be made!

The World's Biggest Business Needs You! Get into this gigantic Auto Business! IT NEEDS YOU! Think of it—5 Thousand Million Dollars paid to Auto Men every year for upkeep alone! Learn about the tremendous opportunities for Auto Experts—opportunities waiting for YOU! If you can read this, clip coupon now. Common schooling all you need. I give you Employment Service for your Entire Lifetime—also Lifetime Consultation Service.

LEARN AT HOME! The Famous COOKE "JOB-WAY"

Keep your Present Job. As Directing Engineer, Owner, and Head of this big Institution. I know what practical Training you need for Big Pay—and that Training I give you! Mine is the only "Job-Way" Training on earth! Includes ALL Electrical Work—Ignition, Starting, Lighting—All Mechanical end, Welding, Brazing, Vulcanizing, also Business Course, Salesmanship, Buying, Advertising, How to keep Simple Books—also Magazine—also 4 Outfits. Nowhere else that I know of can you get all this Training. **Start to Make Money Quick!** Get the Facts! See how Jobs and Raises are Gotten, Businesses are built—in a few months. My Free Book will show you. Send for it now. Address me personally, B.W. COOKE, Directing Engineer, CHICAGO MOTOR TRAINING CORPORATION, 1916 Sunnyside Ave., Dept. C-25, Chicago, Ill.

MAIL "JOB-WAY" COUPON

B. W. Cooke, Directing Engineer, Chicago Motor Training Corporation, Succeeding Chicago Auto Shops, Dept. C-25, 1916 Sunnyside Ave., CHICAGO, ILL.

Send me absolutely FREE and without obligation. Your Auto Book and proof that I can become a BIG PAY AUTO MAN at home in spare time. Also, send your Special 4 Outfits Offer. It is understood that no salesman will call on me.

Name _____
Address _____
Town _____ State _____

4 BIG OUTFITS INCLUDED

TOOLS, TOOL BAG, 293 WIRING DIAGRAM CHARTS, TEST BENCH, RADIO SET—ALL EQUIPMENT INCLUDED! Wonderful Offer right now. I'll give you all this if you act quick! Send Coupon for details.

Money Making Opportunities

DISTRIBUTORS AND REPRESENTATIVES WANTED

DISTRICT Salesman: Experienced man to introduce line of finest all wool suits at \$23.50 to the men of your town. This is an exceptional opportunity for the right man. If you are reliable and responsible and can furnish satisfactory references let us hear from you at once. Address Dept. 520, William C. Bartlett, Inc., 850 W. Adams St., Chicago.

THE Clothing Industry is the second largest business in the country. Men have made fortunes in it. So can you if you go into it right. We'll put you into it right without one penny of expense to you, supply everything you need to get into the business and clear from \$100.00 to \$200.00 a week, from the start. This is a wonderful opportunity for the right man—but he must be "right." He must be honest, dependable, able to sell, and above all, he must be willing to work hard for success. If you are such a man, and are looking for an opportunity such as we offer, let us hear from you. Address Dept. 722, Goodwear, Chicago, Inc., 844 West Adams Street, Chicago.

DOGS

COLLIES for Sale. Training Book 35c. F. Clark, Bloomington, Ill.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

DUPLICATING DEVICES

SEE our advertisement page 13 DUPLICATION.

EDUCATIONAL AND INSTRUCTION

USED correspondence school courses save over half. Bargain catalogue 1000 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d Street, New York.

"DOUBLE entry bookkeeping mastered in 60 hours, with 8 keys; guaranteed; diploma." International Bookkeeping Institute, Desk 10, Springfield, Mo.

BOOKKEEPING in a week, \$2 complete. Duker, 640 West 151st Street, New York.

HIGH School, Normal, Business, Law and Collegiate courses thoroughly taught by mail. Typewriting course free. Apply Carnegie College, Rogers, Ohio.

CORRESPONDENCE Courses sold complete: 1-3 usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, 202-N, West 49th St., New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 17.

CORRESPONDENCE Courses bought and sold. Handling, 799-X, Broadway, New York.

FORD ACCESSORIES

FORDS! 44 miles on one gallon of gas! It has been proven such mileage can be made. Airlock guaranteed to increase gas mileage. Prevents radiator boiling in summer, freezing in winter. Positively cools, fuels, de-carbonizes Ford motor. Agents making big-money distributing our products. Write Airlock Products, Box 703F, Willow Street, Long Beach, Calif.

44 MILES on 1 gallon—Wonderful Vapor Humidifier for autos. 1 free to introduce. Critchlow, PS-G 120, Wheaton, Ill.

FOR INVENTORS

INVENTOR'S-Universal-Educator contains 900 mechanical movements; 40 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Special price (for a limited time) \$1.00 postpaid. Albert E. Dieterich, 681 Ouray Bldg., Washington, D. C.

UNPATENTED Ideas Can be Sold. I tell you how and help you make the sale. Free particulars (Copy-righted). Write W. T. Greene, 805 Jenifer Building, Washington, D. C.

PATENTS Sold; or placed on Royalties, for immediate action write Arthur S. Billings, Suite 401 Dekum Bldg., Portland, Oregon.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

I SELL Patents. Established in 1900. Charles A. Scott, 773PS, Garson Avenue, Rochester, New York.

IF you have a practical, useful invention to sell, write promptly. American Patents Corporation, Barrister Building, Washington, D. C.

MR. INVENTOR. If you have a patent or invention for sale. Write Hartley, 44 Central St., Bangor, Me.

INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 Enright, St. Louis, Mo.

GET Your Own Patents. Instructions, legal blanks, \$1. Cooper Cutting, Campbell, Calif.

MECHANICAL drawing. Difficult designs. Your ideas developed secretly, safely. Write Baskerville Engineers, Farley Bldg., Birmingham, Ala.

INVENTORS—who derive largest profits know and heed certain simple but vital facts before applying for patents. Our book, Patent-Sense, gives those facts free. Write Lacey & Lacey, 648 F St., Washington, D. C. Established 1869.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

FORMULAS

50 MAIL, ORDER plans and 450 formulas, 50c. Pen-tland Co., Norwalk, Conn.

FORMULAS: your favorite beverages, syrups, flavors, extracts, etc., Others. Free information. The Formula Co., West Howe at Second, Seattle, Wash.

FOR MEN AND WOMEN

DETECTIVES—Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

GENUINE Indian Made Baskets, Blankets, Wampum, Catalog. Gilham, Kelseyville, Calif.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

ARE you old at forty? See our advertisement on page 117 of this issue. The Electro Thermal Company, 4048 Main St., Steubenville, Ohio.

FOR SALE AND EXCHANGE

FOR Sale: Watchmaker's Lathe at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Mo.

MR. MANUFACTURER. Layman or veteran—Side Dump Scraper Hoist, loads wagons, does ditching. E. B. Hawkins, Applegate, Ore.

SPECIAL! Manufacturers direct sale of guaranteed 10 Karat solid gold cuff-links only \$2.50; postpaid while they last. Eliminating dealers, saves half. Illustrated circular free. Theander Novelty Co., 246 Fulton Street, Brooklyn, N. Y.

GOT something to swap? Write me, enclosing reply postage. Vitalis Malloy, Dept. 96, Johnsonburg, Penna.

FOR THE HOME

HOME Weaving—Looms only \$9.90. Big money in weaving Colonial rugs, carpets, etc., from rags and waste material. Weavers are rushed with orders. Send for Free Loom Book, it tells all about home weaving and quotes reduced prices and easy terms on our wonderful new looms. Union Loom Works, 482 Factory St., Boonville, N. Y.

GRANDFATHER clock works \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

HELP WANTED

MEN to build radio sets in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, East Bethune Avenue, Detroit, Michigan.

MR. BRUSH Salesmen:—Old Established New York Brush Manufacturer requires the services of men in all territories to sell their extensive line of Sanitary Twisted in Wire Brushes. We pay larger commissions than any other Brush House in the country. Write immediately for our proposition. Wire Grip Sanitary Brush Corp., 15 Mercer St., New York.

ABSOLUTELY no competition selling Val-Style millinery. Every woman buys. You make \$25 to \$150 a week. Write for Special Offer and Exclusive Territory Val-Style Hat Co., A63, Val-Style Building, Cincinnati, Ohio.

ARE you old at forty? See our advertisement on page 117 of this issue. The Electro Thermal Company, 4048 Main, Steubenville, Ohio.

44 MILES on 1 gallon—Wonderful Vapor Humidifier for autos. 1 free to introduce. Critchlow, PS-H 2, 120, Wheaton, Ill.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

HELP WANTED—INSTRUCTION

MEN, 18 to 35. Become Railway Mail Clerks. Commence \$1900 year. Common education sufficient. Sample examination coaching—free. Write today. Franklin Institute, Dept. E-36, Rochester, N. Y.

MEN wanting forest ranger, railway mail clerk and other government positions, write for free particulars of examinations. Mokane, Dept. B-30, Denver, Colo.

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, \$117-\$250, traveling or stationary, write Mr. Osment, 295, St. Louis, Mo., immediately.

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RAILWAY Postal Clerks, \$1900-\$2700; Postoffice Clerks, Carriers, \$1700-\$2300. Many other splendid opportunities. Thousands appointments annually. Information Booklet free. Chicago Civil Service College, T-226 Kesner, Chicago.

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INCORPORATE Delaware. F. Lewis Mettler, 532 Market St., Wilmington, Del. (Established 1909.)

DELAWARE Incorporator. Charters: Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

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INVESTIGATE how \$100, legitimately developed \$2500 assets in two years. No canvassing. Your buyer pays cash, Suite 237, Monadnock Bldg., San Francisco, Cal.

INFORMATION

COMPLETE, accurate information on any subject, \$2 National Information Bureau, 1429B Milton St., Grand Rapids, Michigan. Prompt service.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See Page 17.

ADVICE, information, any subject. Guaranteed \$2.00. Klotz, 927 North Ninth, Reading, Pa.

More Money Making Opportunities on pages 6 to 15

Money Making Opportunities

INSECTS WANTED

WHY not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth \$1 to \$7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my Illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Box 1424, Dept. 7, San Diego, California.

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GUARANTEED Reliable Formulae, Trade Secrets, Rare, Dependable Manufacturing Processes for all lines, detailed working directions, "inside" commercial information. Don't buy till I've sent you my valuable literature. Lists, Satisfaction Guaranteed. Dr. Liscomb Miller, Industrial Chemist, Tampa, Florida.

CHEMICAL catalogue for experimenters, 5c. George Ott, 1218 Chestnut, Reading, Penna.

YOUR chemical problem solved. Formulas for every business and any purpose. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

LANGUAGES

WORLD-ROMIC System, Masterkey 5,000 languages—Primers, \$1.98. Alphagams, 30c. Arabic, Bohemian, Chinese, Danish, Dutch, French, German, Greek, Hindustani, Irish, Italian, Japanese, Latin, Norwegian, Polish, Portuguese, Russian, Sanskrit, Spanish, Swedish. Languages Publishing Company, 8 West 40th, New York.

LETTER SPECIALISTS

QUERX Sales Letters Get More Business. Write Him today. Querx, 4418 Michigan Avenue, Chicago.

MACHINE TOOLS AND MACHINERY

NO. 60 Heald auto cylinder grinder, \$750. One U. S. Milling machine \$125. 20" Silver drill press \$55. 15" Hundy shaper \$215. 16" x 6' Porter engine lathe \$175. 20" x 16' Lodge and Davis engine lathe taper attachment \$550. Terms to suit on single machine or complete shop. Complete line machine and supplies. Cincinnati Machinery Supply Co., 213 E. Pearl Street, Cincinnati, Ohio.

USED PRINTING Presses, Type, Supplies. List 2c. Norfolk Press Works, Ballentine Station, Norfolk, Va.

MAIL ORDER BUSINESS

\$50 a week, evenings. I made it. Mail order business; booklet for stamp tells how. Sample and plan 25c. Free, 12 articles worth \$3. Alps Scott, Cohoes, New York.

INSIDE information and source of supply 25c Superior Sales Service, Norwood, N. Y.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts. Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

MANUFACTURING

PATTERNS, wood and metal. Models, tools and dies. Brass, bronze, aluminum and iron casting. Screw machine work, production work of all kinds. Write Modern Machine & Pattern Co., Terre Haute, Ind.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 17.

DIES, Tools and General Manufacturing. Models and manufacturing of new inventions our specialty. Logan Machine Co., 126 S. Clinton St., Chicago, Illinois.

MISCELLANEOUS

FORMS to cast Tin Soldiers, Indians, Marines, Trappers, Animals. Send 5c for Catalogue. Henry C. Schiereke, 1034 72nd St., Brooklyn, N. Y.

ABSOLUTELY new mail order plan. New article few dollars will start. Complete details for \$2. Circular free. W. H. Blair, Box 10, Lamoni, Iowa.

LAW—advice—fifty cents. Reliable, thoroughly experienced lawyers, civil, criminal, domestic matters. Confidential. Explanation—Blanks free! Emmons and Emmons, Lawyers, Canton, Ohio.

THE SECRET. How to tin a soldering iron so it won't burn off when red hot, is 50 cents. A. B. Bergstrom, Norfolk, Nebr.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

HULIT & CO. General Model Makers, 625 W. Jackson, Chicago. Specializing in high-grade model work on inventions of merit. Our complete equipment insures good work at lowest prices. Try us when you wish something better.

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED—200 Used Motorcycles. Must be sold at once. We have Harley-Davidsons, Indians, Hendersons, Excelsiors, Clements. Prices \$25.00 up. Write for our Bargain List. Myerow Brothers, Dept. C, 15 Berkeley St., Boston, Mass.

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

GOOD Used Motorcycles, Indians, Harley-Davidsons, Ace, Henderson and Clements. Price \$25.00 and up, purchased through our Co-operative Plan for as low as \$1.00 down and \$1.00 a week. Motorcycles shipped to all parts of the world. Walker Indian Co., 188 Mass. Ave., Boston, Mass.

MOTORS, ENGINES AND MACHINERY

MOTORS—New G. E. 1/4 H.P. \$12.50, 1/2 H.P. \$28.50, 1 H.P. \$45. Generators—Radio Transmission 500 V. \$28.50. Battery Chargers—Farm Lighting Generators. All sizes. Lathes—Drill Presses—Air Pumps—other Garage and Shop Equipment. Wholesale prices. New catalog. Motor Specialties Co., Crafton, Penna.

CONCRETE Building Block Machines and Molds. Catalogue free. Concrete Manufacturing Co., 307 So. Third St., St. Louis, Mo.

MUSICAL INSTRUMENT

SAXOPHONISTS—Clarinetists—Cornetists—Trombonists—get "Free Pointers." Virtuoso Music School, Buffalo, N. Y.

More Money Making Opportunities
on pages 6 to 15

CARPENTERS AND BUILDERS!

INFORMATION

Contents of the Guides, giving inside information on modern methods, ideas, short-cuts. All very practical, easy to understand and follow.

GUIDE No. 1

431 Pages—1200 illus.
How to know the different kinds of wood.
How to use the different kinds of wood.
Complete detailed information on nails and screws.
How circular and band saws are handled.
How to use the steelsquare.
How to sharpen tools.
How to file and set saws.
How to make wood joints.
Complete information regarding joints and joinery.

How to build furniture.
How to make a work bench.
How to make a mitre box.
How to make a mitre shooting board.
How to plumb and level work.
How to use the chalk line.
How to lay out work.
How to use rules and scales.
How to use all of the carpenter's tools, with over 900 illustrations showing specifically how.

GUIDE No. 2

455 Pages—400 illus.
How to understand carpenter's arithmetic.
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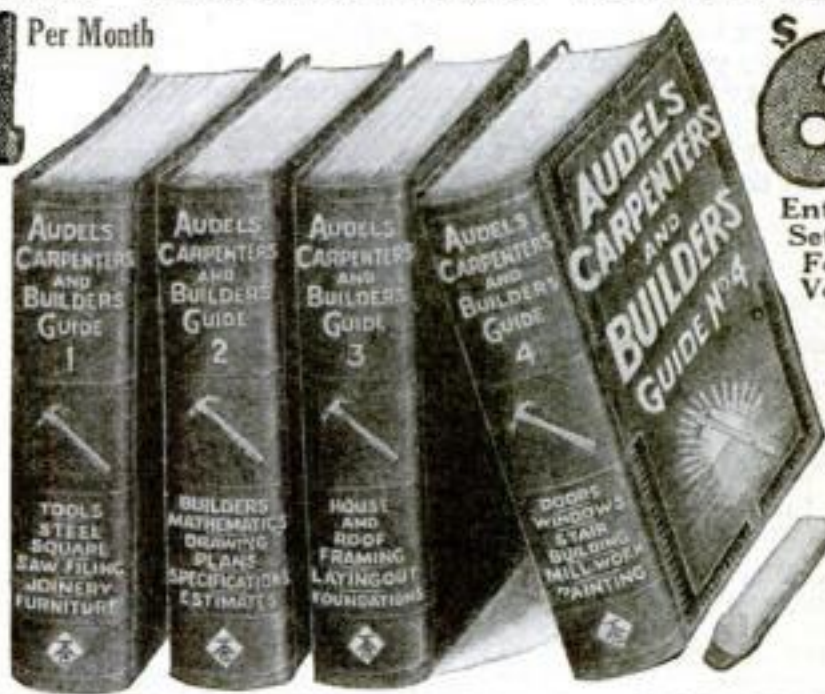
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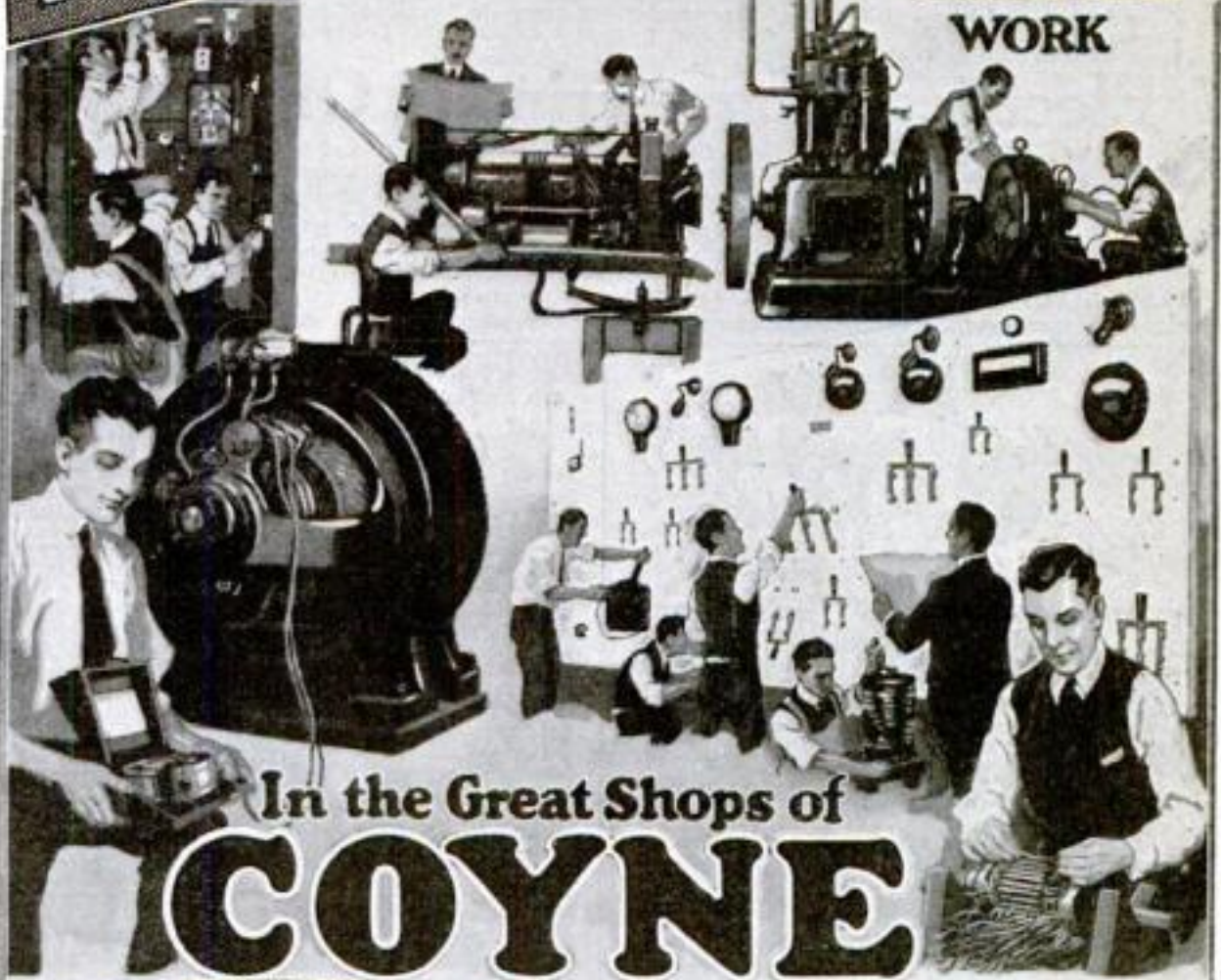
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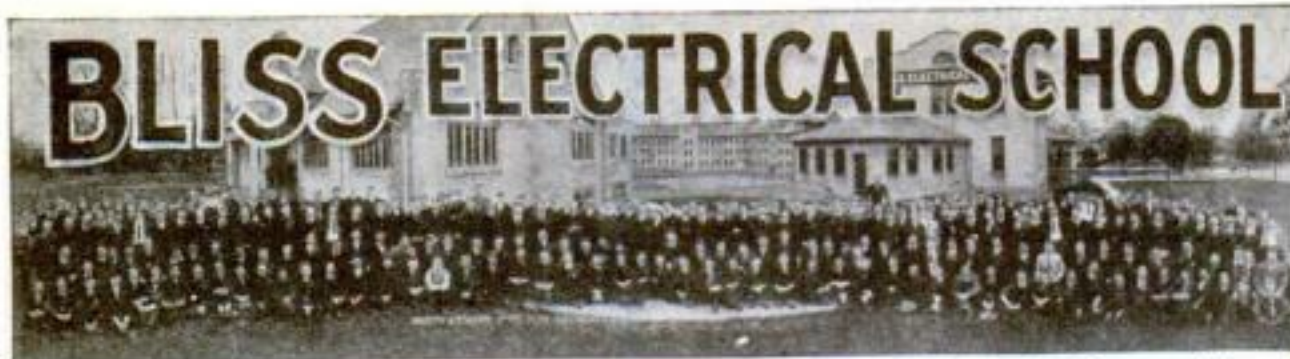
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AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn \$100 weekly and bonus. Madison Mfgs., 511 Broadway, New York.

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SALESMEN Sell Four Square Suits, \$12.50; guaranteed two years. Five patterns. Profit in advance \$3 to \$5.50. Coat, vest, pants, riding pants, slip-ons, caps. Women's knickers, Jiffy Snap-ons. One day delivery. Stone-Field, CL, 2556 Wabash, Chicago.

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More Money Making Opportunities on pages 6 to 15

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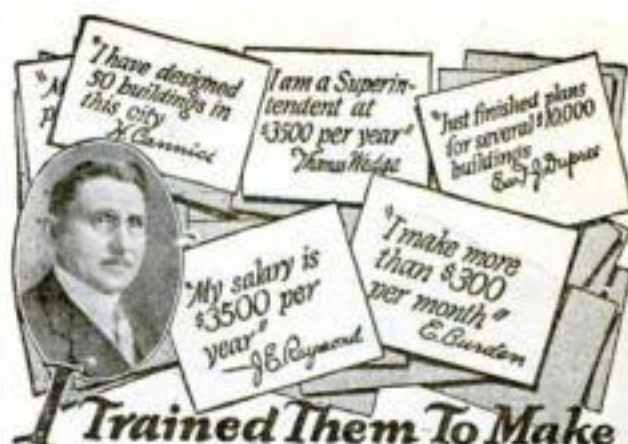
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More Money Making Opportunities
on pages 6 to 15



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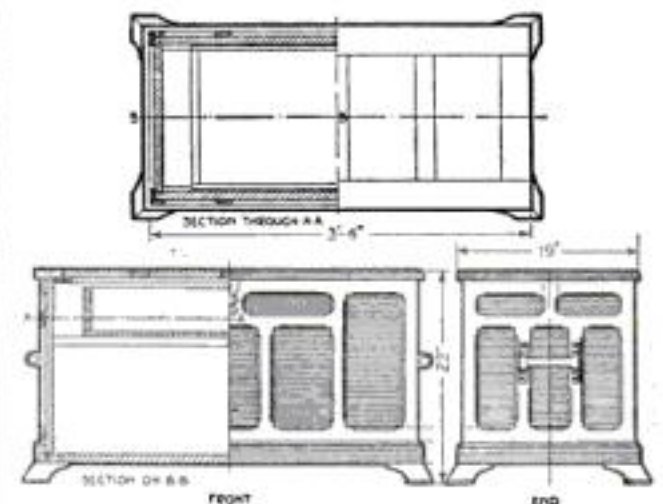
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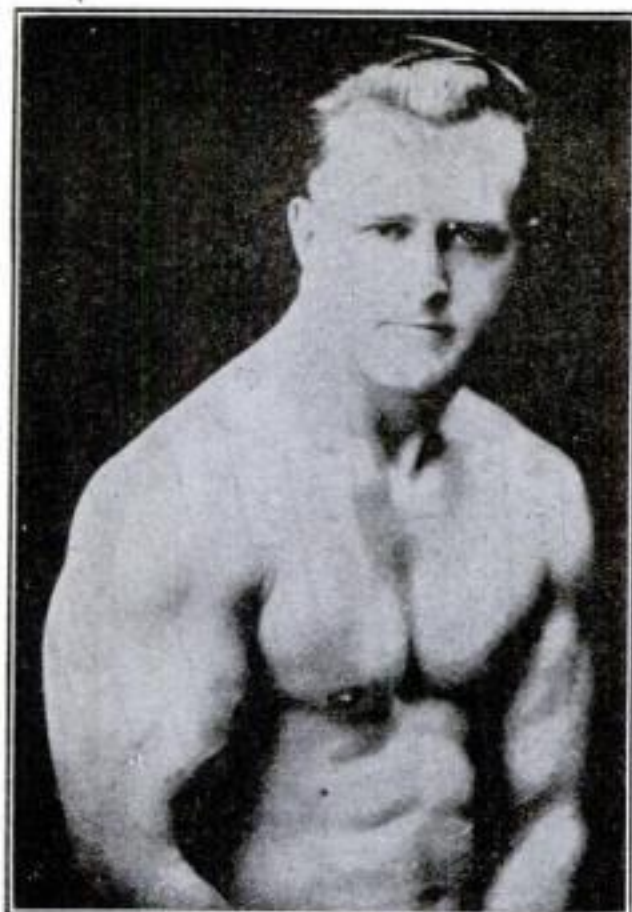
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That's what the big, robust two-fisted fellows of strength, muscle and health are saying to the weakling—the weak, narrow-chested chap with the shifty eyes, who cannot concentrate and who just cannot carry on in this battle of life, where only the strongest survive.

Look here, young fellow, just sit down and think this thing over. Are you going through life taking orders and obeying the commands of the other fellow? Do you want to be stepped over and left on the bottom of the pile with the ringing cry in your ears "Get Off the Earth!"

DEAD OR ALIVE

Do you awake in the morning with the dread of the day's work ahead of you and after managing to perform your duties, you go trudging home with drooping shoulders and dead tired—good for nothing but the bed, OR—

Do you awaken fully refreshed, tickled to death to be alive? Do you spring out of bed, thrilling with vitality and anxious and ready to meet your responsibilities with that spirit that "cannot be beat?" That's living!

Let me repair that body of yours. I am a muscle builder. I build energy. I make go-getters. I make live he-men. I will clear your brain and put that healthy sparkle in your eye. Then you can tell the whole world you will come out on top when it's all over. Before you realize it, people will begin noticing you. They won't pass you by again. Opportunities will spring up and you will start climbing the ladder of success. I will make you a big, broad shouldered, two-fisted fellow who gets there. Everyone will like you. Only the fellow who is alert, wide-awake, gets the opportunities. Your abundant strength and thrilling vitality will stimulate your ambition and fire you on until you are bound to success.

HEY—WAKE UP!

How do you expect to go through life half dead, half alive—a sort of "half-man," who cannot stand out from the crowd? Come on, straighten those shoulders, broaden that back. Do something to fill out that suit of yours—GET SOME MUSCLE. In thirty days or even less I guarantee to add one full inch to your arms, yes and two more inches to your chest. Not only that but you will begin to live all over again. You will breathe deeper, sleep like a rock, enjoy every mouthful of food you eat. You will feel and act altogether like a new person and that's only the beginning. That's where you start. From then on you will enjoy the work. Your progress will amaze you. You will wonder why in the world you have been asleep so long. And remember, fellows, I absolutely guarantee to do these things for you and guarantee them in the fullest sense of the word. You will feel like shouting to the whole world—"I am a man and I can prove it."

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DETECTIVES needed everywhere. Experience unnecessary. Particulars free. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

MELODIES, Songs, Poems wanted for publication H. Nielsen, 2609 Hennepin, Minneapolis.



Earn \$50 to \$250 a Week As a Radio Expert

If you are making less than \$50 a week—if you want to jump quickly into the Big Pay Class—in the world's fastest growing industry—get into Radio NOW. Coupon below brings full information—it is your Ticket to Success.

Big jobs are open for trained men everywhere. We receive calls regularly for Radio experts, Radio manufacturers, dealers, broadcasting and receiving stations, railroad and steamship companies, government departments need Radio Experts NOW. Pay is big. Thousands now make \$50 to \$250 a week in Radio.

Easy to Learn at Home

The National Radio Institute (America's largest and oldest Home Study Radio School) will train you at home, in your spare time to become a Certified Radio Expert. No red tape—no long drawn out delays. In a few short months by the famous National Radio Institute tested method you can become the Radio expert of your own town or wherever you wish to locate.



N. R. I. Men Land Big Jobs

Letters from our students prove that N. R. I. training, plus our Employment Service puts our graduates in the Big Pay Jobs where real money is made. See what these National Radio Institute men say:

Makes \$50 to \$80 a Week More

Your course leads so much further ahead than practical electricity that there is nothing left to say. Since I took your course I have earned from \$50 to \$80 a week more. Preston Fowler, Gordon, Nebraska.



Increases Pay 160%

I was just receiving \$3.00 per 8 hours when I enrolled with N. R. I., and now I am receiving \$1.00 an hour more (160% increase). That is where N. R. I. put me. The course has been worth \$2500 a year to me and in another year it will be worth \$3500 a year. While taking the course I did assembling, repairing and installing and made about \$900. This made my course pay for itself many times even before I graduated. The N. R. I. is the Right way.

Andrew M. Shurie, Latrobe, Pa.

Up-to-date receiving sets given with course. National Radio Institute training is practical training—not merely text books but real work on real parts and receiving sets furnished Free to you. You learn to design—build—repair, install and operate your own sets—it is like ABC.

SPECIAL OFFER—ACT QUICK

The coupon below brings you the most Amazing Book on Radio ever written. It tells you how to turn a pastime into a Gold Mine. Important: We have a Special Limited Offer for those who act quickly. Mail the coupon NOW.

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Please send me without the slightest obligation your Free Book, "Rich Rewards in Radio," and full details of your special Free Employment Service. Please write plainly.

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When you see a "Hex"—think of BLACKHAWK!

Steel Ferrets!

IN after hidden nuts and bolts, seizing them with jaws of steel that never loosen until you pull them off—Blackhawk "Q.D." Wrenches are like little ferrets, fierce and efficient. Manifolds, universals and axles secrete no nuts that can escape your "Q.D." set. Choose the socket that snugly fits, and the handle with the right reach and leverage—click!—and you have a socket wrench that saves time, temper and knuckles!

Your dealer will hand you a special "Q.D." set for your car. Notice the nice "heft" of the handles, the comfortable grips, the husky sockets, and the baked-on, all-black finish. Quality! If the dealer is not yet stocked, write us direct.

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Water Pumps for Fords



A Set for
Every Car

BLACKHAWK Welded Wrenches

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In Buying Vacuum Tubes

—Look Out!



Alexander Senauke, Radio Engineer of the Popular Science Institute of Standards, is shown here testing vacuum tubes on the apparatus used by the Institute. The bridge arrangement shows the internal capacity of every vacuum tube tested

By Alexander Senauke, M. E., E. E.

Radio Engineer Popular Science Institute of Standards

THERE is, probably, no other radio product on the market that can hide its merits or demerits quite so thoroughly as a vacuum tube.

Every vacuum tube looks like every other vacuum tube; but, unfortunately—or perhaps fortunately—they all do not perform alike. In the case of some radio products there are points of construction, etc., for which the purchaser can look, but in vacuum tubes there is no distinguishing feature that will give a clue to the efficiency of the product. As a result, the inexperienced purchaser of radio products is quite likely to be misled by price.

There are a number of tubes being sold to-day whose price compares favorably with standard tubes, but whose efficiency is not at all comparable. Noting the similarity in appearance, the purchaser who has not suffered already by experience very likely will attribute the difference in price to the cost of a "big name." He buys the unknown tubes once—but not twice.

BEFORE any vacuum tube (or other radio or tool product) can be advertised in POPULAR SCIENCE MONTHLY, it must go through a very rigid test in the laboratories of the Popular Science Institute of Standards. There, experts determine whether the tube will give satisfactory service and whether that service will last over a reasonable period of time.

The characteristics desired in tubes are:

1. High amplification constant.
2. Low output impedance.
3. Low internal capacity.

4. Correct ratings of filament, voltage and current.

5. Filament emission that will be little affected by ordinary use.

6. Mechanical construction that will insure against (a) Excess of microphonic disturbances; (b) shortening the life of the tube by ordinary use.

The laboratory tests are based on these requirements. First, the tubes are inspected for construction and finish. The parts are measured in order to determine whether they fit the sockets, etc. Following this the manufacturers' ratings as to filament current and plate voltage are checked.

The Engineers of the Institute next measure the voltage amplification constant, the output impedance, the

internal capacity, and the total filament emission.

Where special design makes it necessary, sufficient additional laboratory measurements are made, so that an analysis of all measured constants will permit of determining the suitability of the vacuum tubes for their intended application.

The effect of normal abuse on filament emission is measured. The tube is paralyzed purposely also, and the effectiveness of the recommended methods of restoration on the particular tube is checked. Actual use of the tubes in their various capacities in different radio receiving sets makes a final check.

The purchaser of radio vacuum tubes has, then, one point to go by in judging the products offered to him. If the tubes bear the seal of approval of the Popular Science Institute of Standards they will give good service—service that has been determined accurately by the tests described above.

POPULAR SCIENCE Monthly Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.

IT IS obviously impractical for even as completely organized a bureau as the Institute of Standards to test all products listed in tool or radio catalogues advertised in our columns. Only tool and radio products specifically advertised in POPULAR SCIENCE MONTHLY are tested and approved by the Institute.

Send for List of Approved Products

POPULAR SCIENCE MONTHLY will be glad to furnish on request a list of Radio and Tool Manufacturers whose products have been approved by the Institute.





Binocular
Coils

Selectivity

—the most important
function of a radio set

Sensitivity—yes.

Clarity of tone—surely.

But *selectivity*—that is the true test of performance.

The extreme selectivity of the Grebe Synchrophase has been made possible by the *Binocular Coils* which, because they have no field, are unaffected by impulses from undesired stations. They keep the set automatically balanced against such interference.

These Binocular Coils are exclusively Grebe, as are also the *Grebe S-L-F* (straight line frequency) *Condensers* and *Grebe Volume Control* which are outstanding features of the Synchrophase.

Ask your dealer to demonstrate these
features or write us

A.H. Grebe & Co., Inc., Van Wyck Blvd., Richmond Hill, N.Y.
Western Branch: 443 So. San Pedro St., Los Angeles, Cal.

The

GREBE

This Company owns and operates stations WAHG, WBOQ; also mobile and marine low-wave re-broadcasting stations.

SYNCHROPHASE

TRADE MARK



The true worth of a machine lies not in its appearance but in its performance.

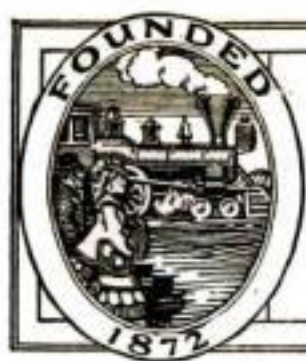
Doctor M



All Grebe apparatus is covered by patents granted and pending.



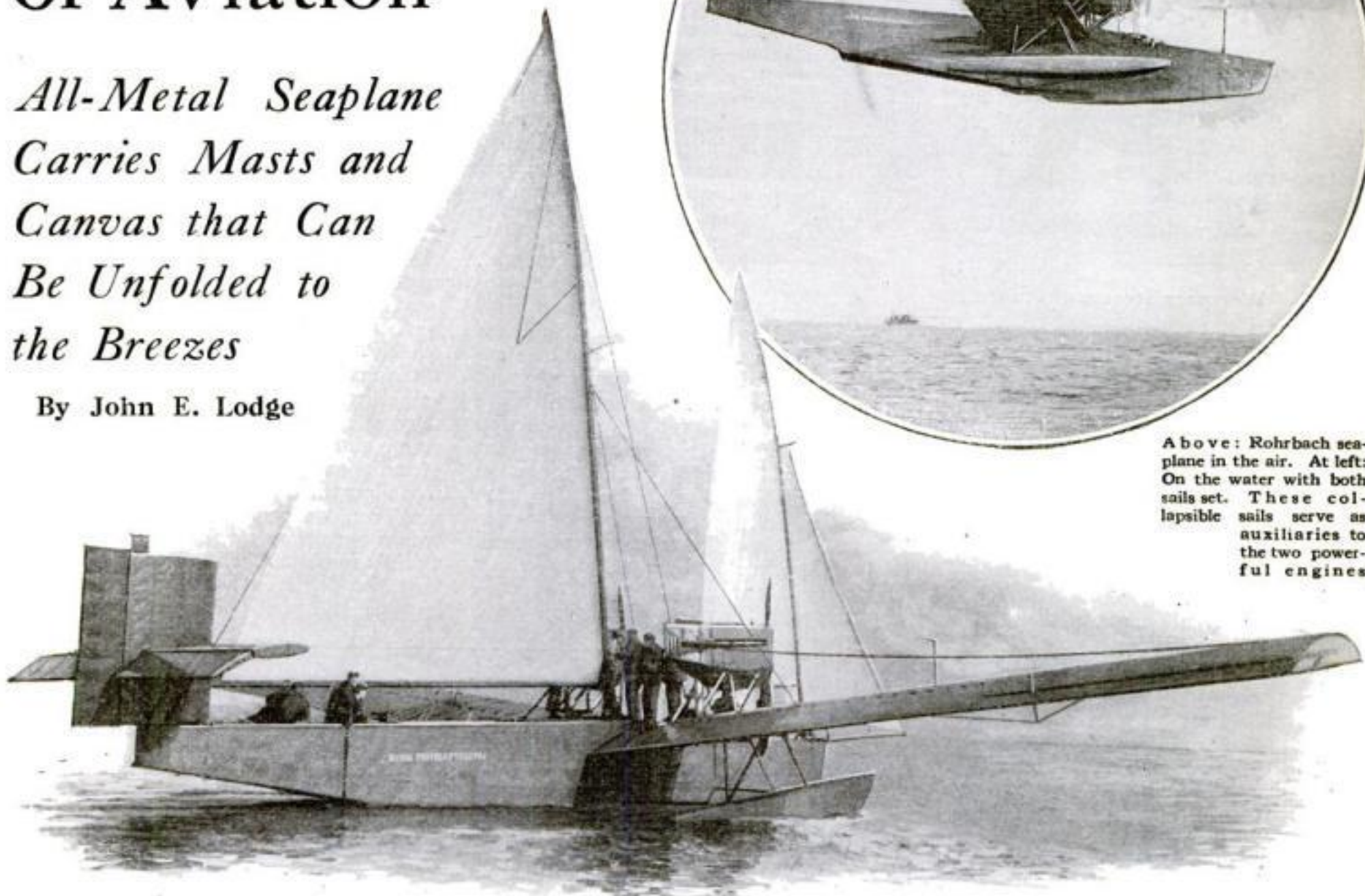
Also supplied with base for batteries



A Flying Sailboat, Newest Marvel of Aviation

*All-Metal Seaplane
Carries Masts and
Canvas that Can
Be Unfolded to
the Breezes*

By John E. Lodge



Above: Rohrbach seaplane in the air. At left: On the water with both sails set. These collapsible sails serve as auxiliaries to the two powerful engines

HIGH above the waters of the Baltic Sea recently a seaplane soared. Suddenly it dived, straightened out within a few feet of the water, and soon was skimming the waves. Observers watched the maneuver with interest that changed to astonishment when they saw two sails rise and spread their white canvas on the hull of the now floating airplane. The sound of powerful engines was reduced by half; evidently only one was running. Then that too was silenced, and the plane scudded through the water, with a snappy breeze behind the sails, as smoothly as any sailboat, though with less grace, owing to the appearance presented by the two great engines raised above the hull of the plane and the wide-spread wings with their upward slant.

This astonishing new type of all-metal flying sailboat pictured here and on the cover of this issue, was completed and tested a few weeks ago by the Rohrbach

Metal Aeroplane Company of Copenhagen. It is constructed of duralumin and built on principles used in bridge and ship-building work, that is, of riveted girders and plates. This structure permits of larger wing spans and the use of more powerful engines. But the real feature of the Rohrbach seaplane is its ability to carry sails, a mainsail, foresail, and jib. These sails are collapsible and may be spread to the wind or collapsed at will.

They serve as auxiliaries to the airplane engines, providing an added element of safety on long cruises. Should one engine fail, the other would still keep the plane going; but should both engines fail, the sails would carry the boat along until the engines had been repaired or until help arrived.

Again, should a tempest drive the plane far from its appointed course, and the fuel supply run low—the sails could be resorted to and the fuel supply conserved.

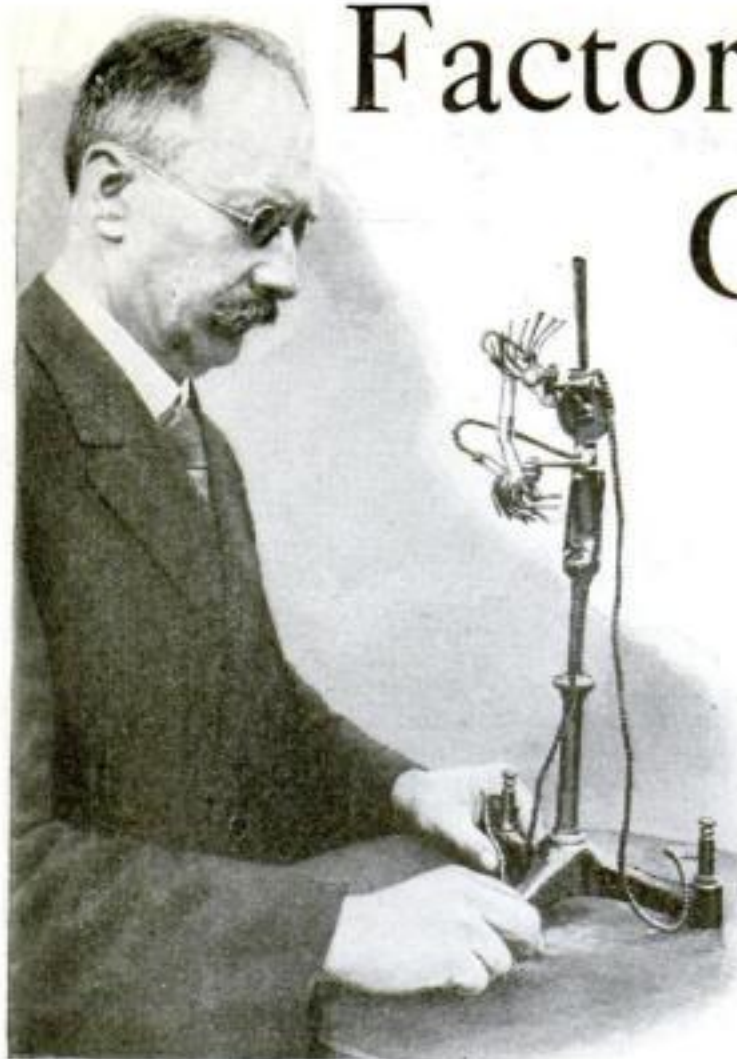
These illustrations give a general idea of the design of the Rohrbach plane. It is of the monoplane type, with cantilever wings set at an unusually acute angle, which is said to aid materially in the machine's control. The wings are so strong that the crew can walk safely along them, a feature that is of considerable value in docking. There are two auxiliary stabilizing pontoons situated under the wings, as well as a beaching trolley.

The hull itself is divided into watertight compartments by bulkheads and is designed so that the machine will float with any two compartments flooded. The two great 12-cylinder engines are mounted above the hull on hollow metal struts that carry the motors and propellers clear of the wing structure. They will develop a speed of 1800 revolutions a minute, furnishing approximately 720 brake horsepower. This newest seaplane marks a distinct new departure in aeronautics.

Factory-Made "Vegetables" Our Future Food?

Nature's Processes Duplicated by Noted French Scientist in Amazing Experiments

By Norman C. McLoud



Discovers Secrets of Plant Life

Daniel Berthelot, world-famous scientist, using the mercury-vapor quartz lamp, which, he predicts, may eventually supplant the plowshare. He has proved that the common gases of the air, when subjected to ultra-violet light from this lamp, combine to produce the principal sugars, duplicating nature's processes in growing plants. In his experiments his eyes are protected from the blinding rays by black spectacles

WHY plant vegetables and till the soil when we can build factories that will actually fabricate our foodstuffs?

Instead of hauling produce across the continent, why not manufacture it from its chemical constituents in the heart of the great cities in which it is to be consumed?

The idea may seem fantastic, but the thing is an accomplished fact. I have seen such a factory in operation. I have talked with the man who made it possible. He is Daniel Berthelot, one of the world's most distinguished scientists.

In his laboratory at Meudon, near Paris, Professor Berthelot already has produced foodstuffs artificially by subjecting various gases to the influence of ultra-violet light. His products have been small in quantity, of course; yet it is because of the success of these amazing experiments that he was able to depict for me in an entirely convincing way, food factories of the future that may take the place, in a large measure, of our farms.

Here is how Professor Berthelot describes his astounding achievement of duplicating in an amazingly simple way processes of

nature that wise men for centuries have considered entirely beyond the power of man to fathom—processes of nature, by the way, which are connected closely with the greatest of all secrets—the creation of life itself.

Bear in mind, always, that these are the words of a practical man of science, long famous throughout the world for his scientific achievements, especially in the use of ultra-violet light.

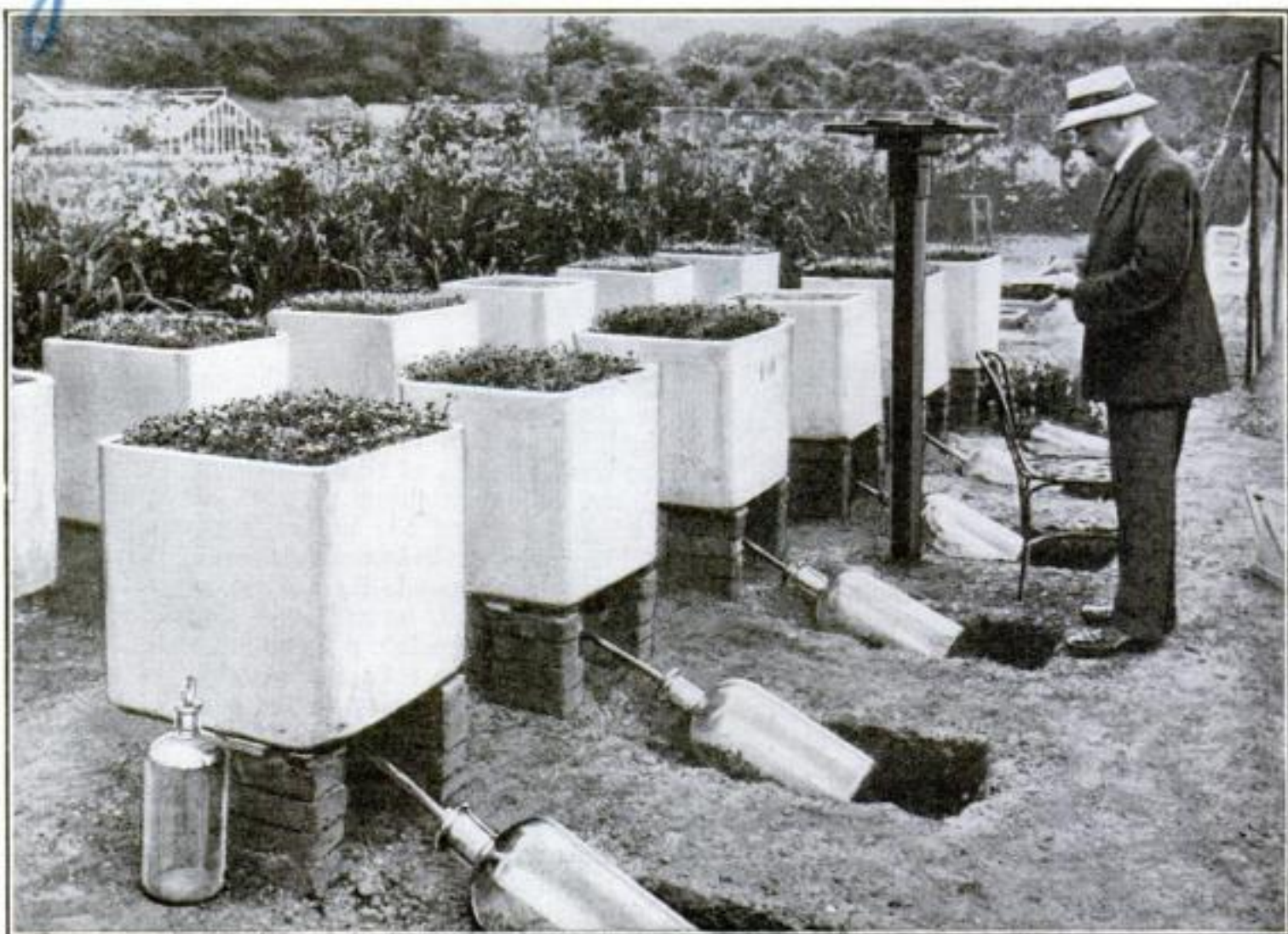
"I see the factory in operation," he told me. "Each unit will be a large room with a low ceiling. The floor will be occupied by glass tanks of great capacity. Each tank will have inlet pipes for the introduction of gases—the same gases that nature utilizes in the production of vegetable foods. Entering at the top, these gases will flow downward, and across the tank. Suspended from the ceiling will be lamps producing the rays of ultra-violet light. In this weird, powerful flood of energizing rays, the gases will be converted

into vegetable material while we watch.

"The process will be dramatic. Through the glass walls of the tank we shall see something in the nature of a gentle snowfall that will accumulate on the floor of the tank in the form of powder that constitutes our finished product—vegetable starches and vegetable sugars created in faithful reproduction of the works of nature.

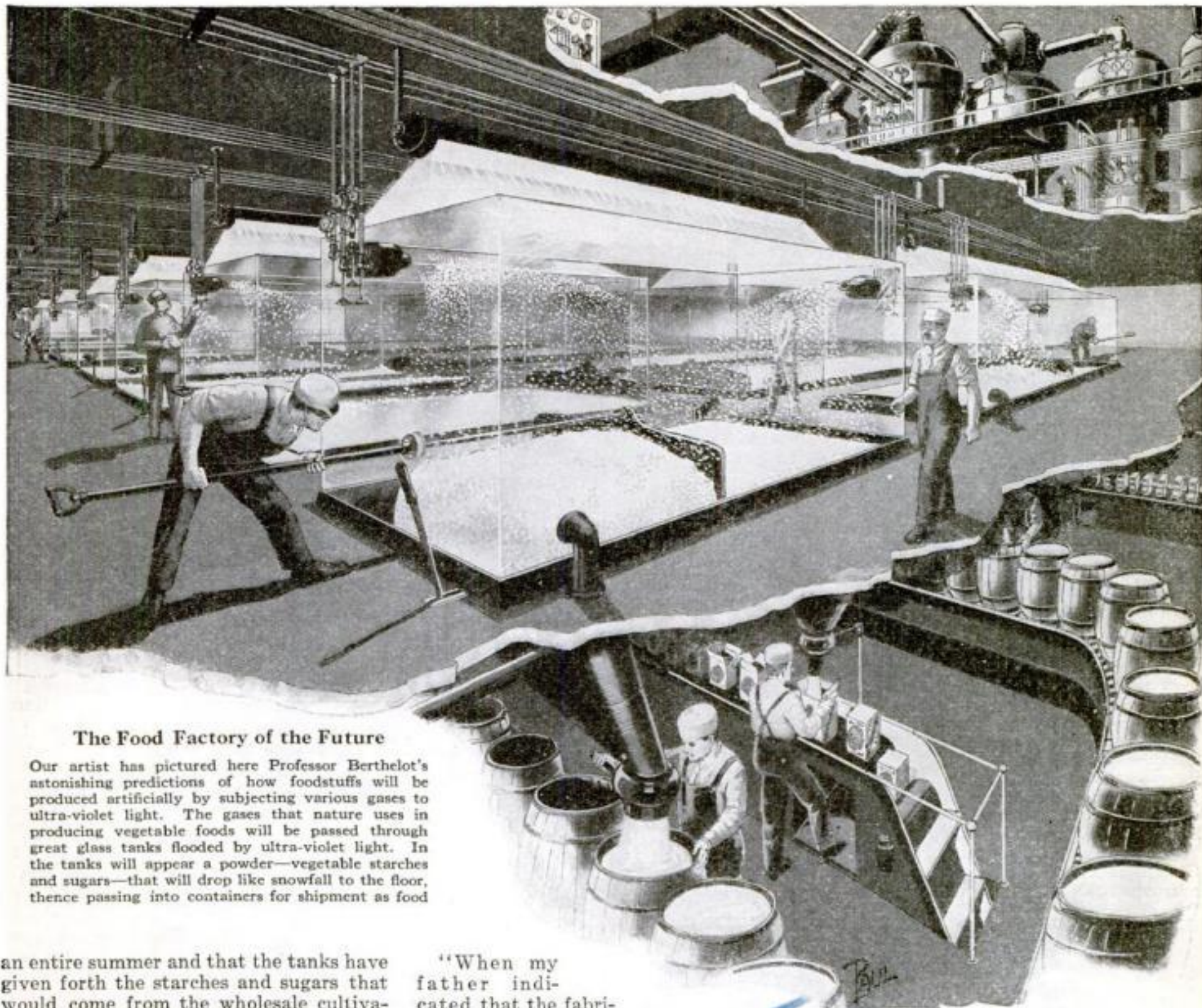
"WE SHALL see workmen in overalls, their arms and faces yellowish green under the powerful glare of the lamps. Each man will wear a pair of goggles, without which he would go blind quickly.

"We shall see the workers using scoops to gather the harvest. While we watch they will be filling barrels or boxes with starch and sugar—the starch from one set of tanks and the sugar from another. If we follow these containers to the shipping platform, we shall see them loaded on trucks or railway cars and sent out to the world's markets. The records will show that the day's output has been equivalent to the yield of a large farm for



Berthelot's Garden of Wonders—A Shrine of Research

Here Professor Berthelot is seen in his remarkable garden studying the part played by insulation and humidity in plant development. The bottle contains water that is carried through tubes to the soil in the vitreous containers



The Food Factory of the Future

Our artist has pictured here Professor Berthelot's astonishing predictions of how foodstuffs will be produced artificially by subjecting various gases to ultra-violet light. The gases that nature uses in producing vegetable foods will be passed through great glass tanks flooded by ultra-violet light. In the tanks will appear a powder—vegetable starches and sugars—that will drop like snowfall to the floor, thence passing into containers for shipment as food

an entire summer and that the tanks have given forth the starches and sugars that would come from the wholesale cultivation of beets and cane."

To his fellow members in the French Academy of Sciences, Daniel Berthelot's discoveries are as familiar as those of the Curies or the epoch-making achievements of Pasteur. His laboratory is one of the shrines of modern research, and his labors have brought him membership in the French Institute, the presidency of the French Society of Electrical Engineers, and the chair of professor in the world-famous Sorbonne of Paris.

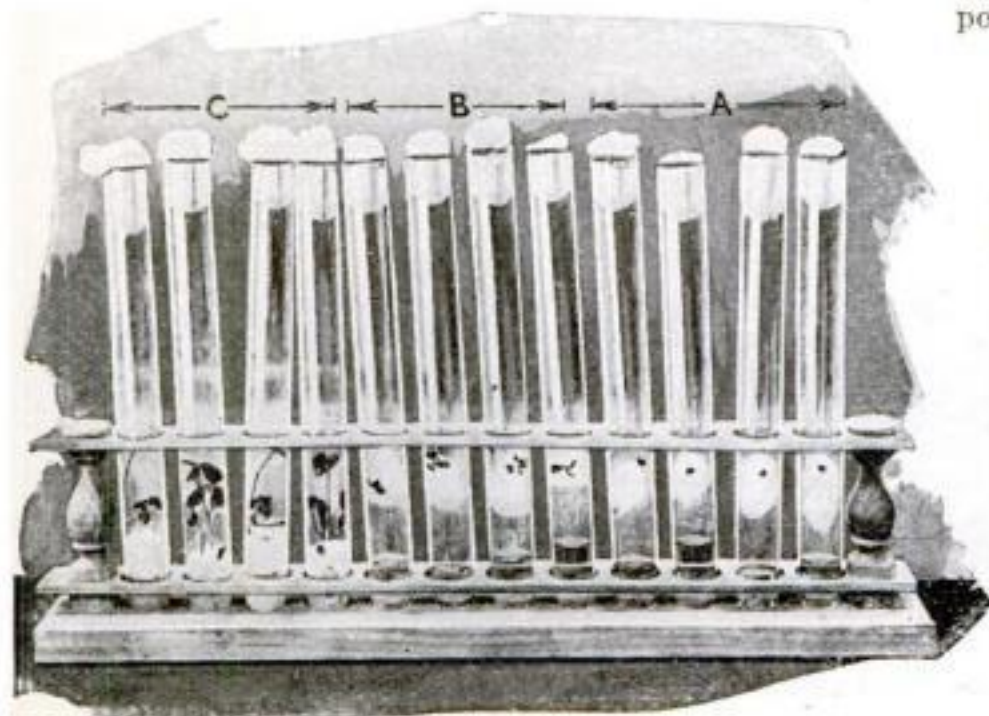
"When my father indicated that the fabrication of foodstuffs was a chemical possibility," Berthelot told me in his garden at Meudon, "some of his contemporaries felt tempted to regard the idea as a silly freak, as you would express it in English. Today the ultra-violet ray has made the supposed freak a matter of tangible fact. These rays have given us a process of admirable theoretical simplicity, closely akin to the methods of Mother Nature herself. In keeping with natural forces, we realize the composition of vegetable

foodstuffs by the utilization of light. We have proceeded on the basis that in the case of sunshine it is the light rather than the heat that produces the growth in plants.

"The breathing of an animal or a human being embodies actual combustion and uses up the oxygen of the atmosphere. In this combustion, the hydrogen and carbon in the body of the animal that are combined in various organic forms are reduced to carbonic acid and water vapor. Growing plants produce exactly opposite results. Under the influence of the sun, the plant takes the two gases exhaled by animals and combines them again to form the sugars and the other hydrocarbons that are foodstuffs of human beings and herbivorous animals.

"Until recently this synthetic function of green plants has not been reproduced in our laboratories. Therefore, many scientists have considered the function an essential and exclusive property of life itself. I have been able to prove otherwise. Right here in my laboratory I have demonstrated that the old theory is wrong. In other words, the changes produced by a growing plant are not the result of vital action, but arise from purely physico-chemical reactions.

(Continued on page 109)



How Rays Affect Plant Growth

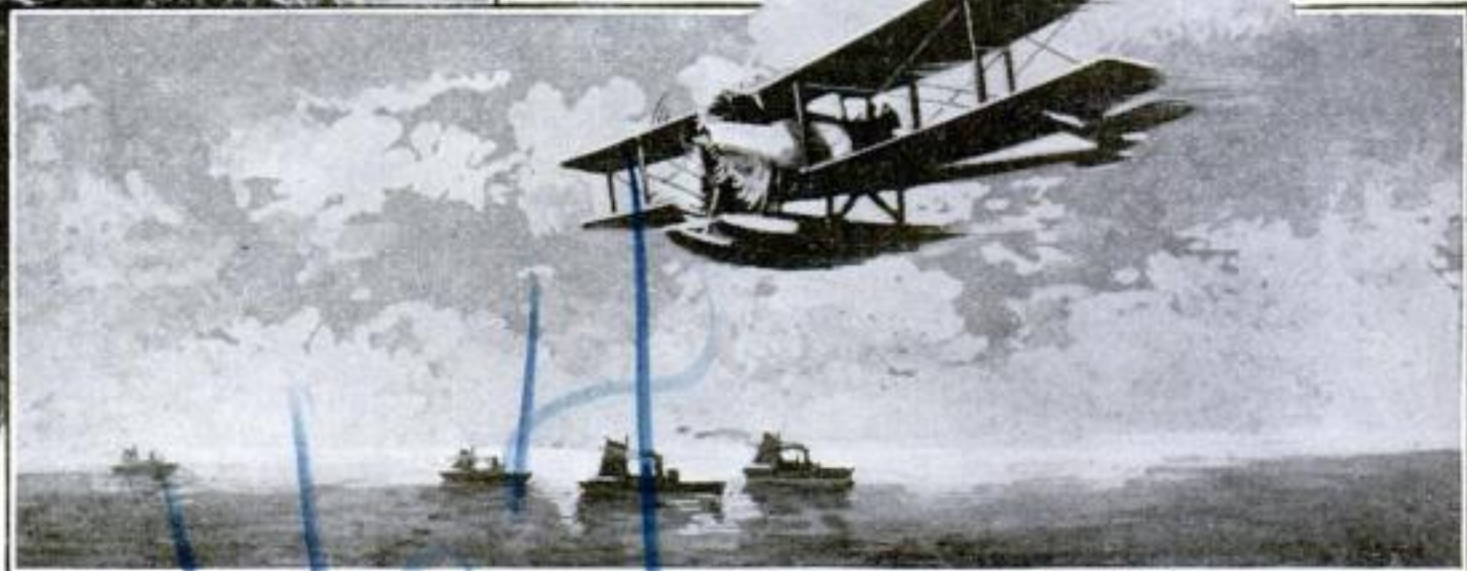
By exposing the test tubes, containing plant seeds, to ultra-violet light at varying intensities and for varying periods, Professor Berthelot proved that plant growth arises from purely physico-chemical reactions. In the four tubes A, the seeds were killed by exposure; in tubes B, the seeds were retarded, while in tubes C the seeds grew normally

The Last Word in Modern Fishing



Hauling in the Loaded Nets

Science has come to the aid of the thousands of men who earn their living every year fishing for herring, the foremost commercial fish. Airplanes and other mechanical devices now are being used to increase the catch. Also reports that herring schools in waters of North America and Europe grow smaller each year, have caused the British Government to send out scientists to find a remedy.



Plane Aids Fishermen

An airplane used to locate schools of fish. When the observer sights a school, he signals to the fishing fleet and the nets are spread for the haul. Fishing fleets of every country now use planes.

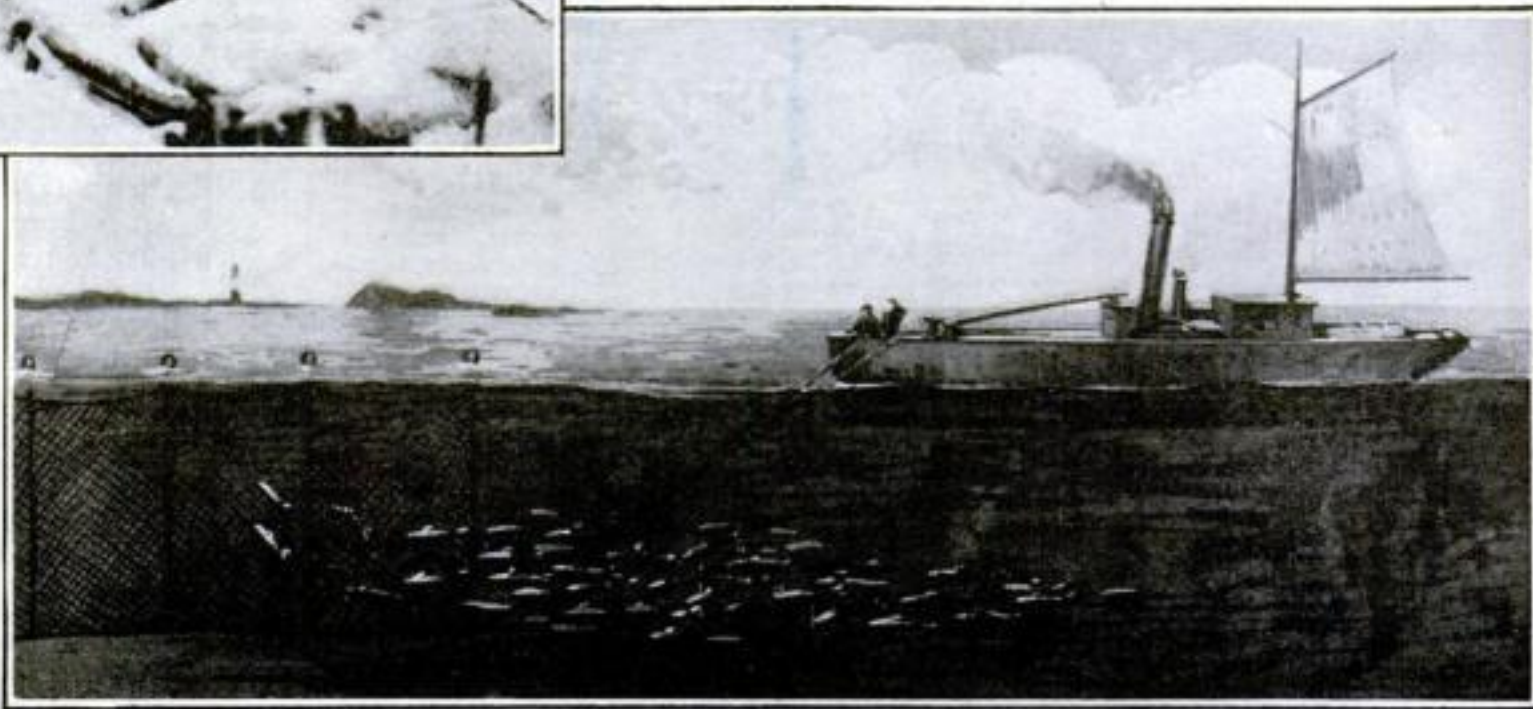


In Northern Waters—Conditions such as the above are every-day experiences to the herring fishermen in winter waters. Frozen spray has covered the vessel, its rigging, and the fishing nets with a heavy and dangerous sheath of ice.

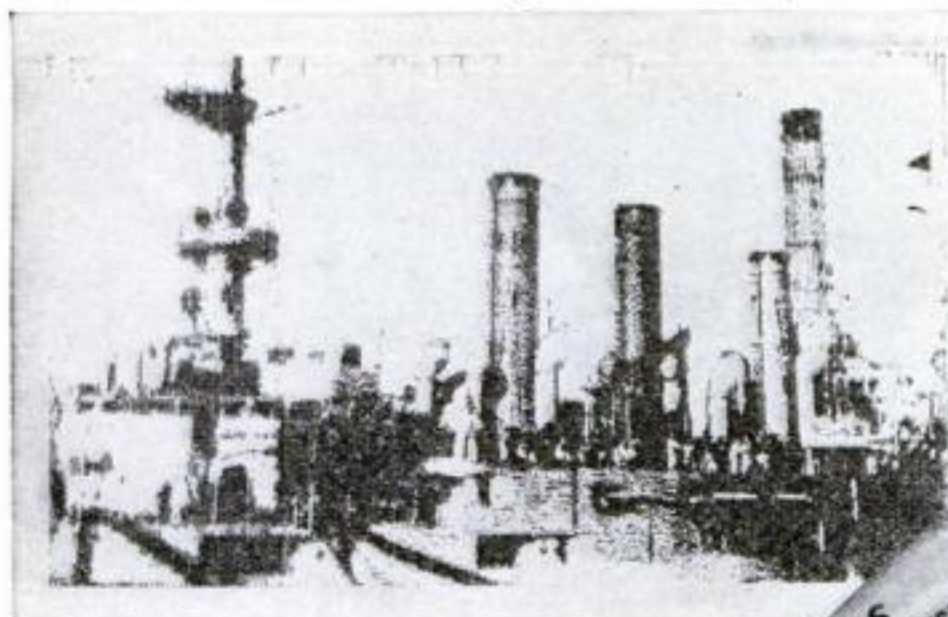


Setting the Nets

Above: Blowing up the bladders that are attached to the nets to keep them afloat. At right: How the fleet operates. After receiving the plane's signal, the boats, called "drifters," spread the nets, sometimes a mile or more long, held up by painted bladders. The mesh of the net is just large enough to admit the head of a herring. When a fish tries to withdraw, its gills prevent its escape.



This Boy Made Radio History



By Radio from Hawaii

A photograph of U. S. warships during the recent maneuvers in Hawaii, as received by radio in New York after a journey 5136 miles from Honolulu. Eight of the war-game pictures were sent by Alfred J. Koenig in record time

OUT in Hawaii this summer a 19-year-old youth from the States is becoming famous. Interested visitors crowd the wireless station where he is operating a machine that sends photographs hurtling 5000 miles across the sea, and men many years his senior listen attentively while he coaches them in the latest developments in radio.

Four years ago Alfred J. Koenig was an office boy. How in that short time he shot from a job of running errands to a place where he was intrusted with one of the most important experiments undertaken by a great radio corporation, is a regular story-book tale, more interesting because it is true.

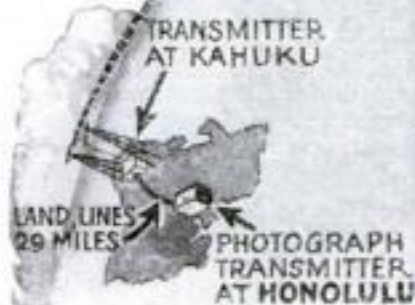
Like thousands of other boys, young Koenig was enthusiastic about radio. He rigged up a radio station at his home in Brooklyn, N. Y., and joined the Amateur Radio Relay League.

In the daytime he went to preparatory school, but every evening found him at the Marconi Institute studying radio. When he was only 15, he passed the test for first-grade commercial operator.

The name "Radio Corporation of America" had a fascination for him and he got a job in the offices. Opening letters wasn't very exciting work, but he liked to be where people were talking radio. He kept on at night school, studying electrical engineering.

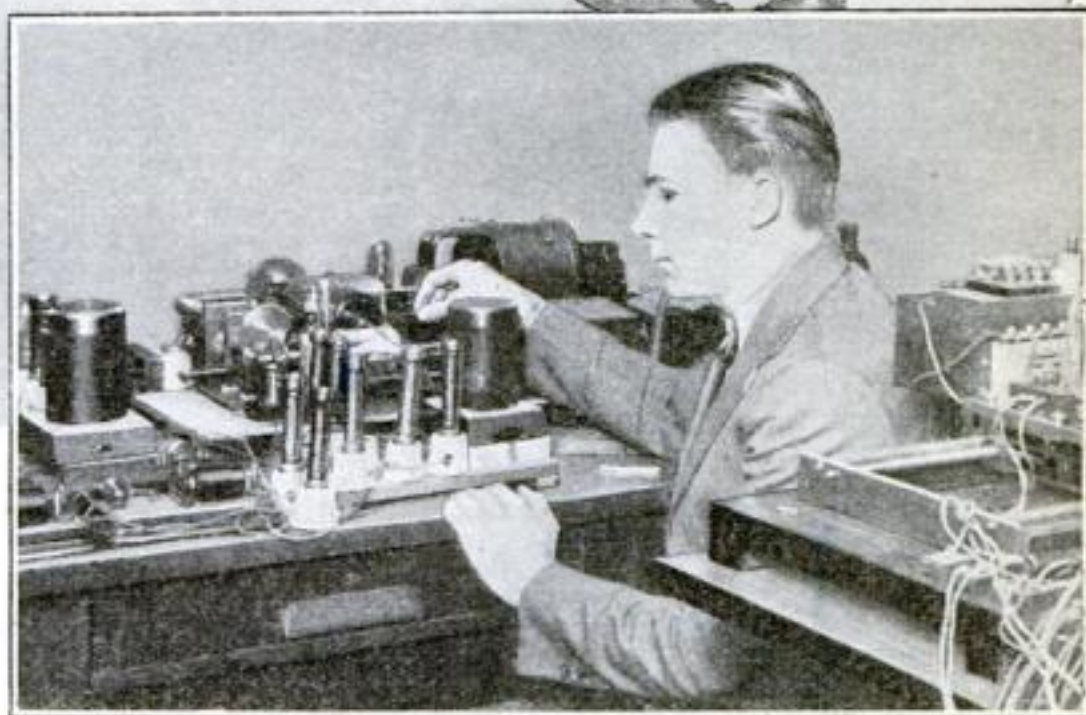
Captain Richard H. Ranger, of the Engineering Department, had noticed him in the office. Alfred Koenig was quick and eager. Captain Ranger got him transferred to the Engineering Department and set him to work doing mimeographing. Gradually he was allowed to do engineering work. The engineers were developing amplifiers with particular reference to relay work.

When the method of sending pictures by radio, invented by Captain Ranger,



A Marvel of Radio

The 19-year-old radio engineer, Alfred J. Koenig, (right) seated at the photo-transmitting machine. The 5136-mile route over which the pictures are relayed from Honolulu to New York, is shown on the map



was developed, Alfred Koenig was in on the ground floor. He had helped work the system out. The day when the first photographs were transmitted successfully from New York to London, was one of the most thrilling he had experienced

THEN the corporation decided to make a second test, much more severe than the transatlantic one. Photographs should be sent from Hawaii to New York, a distance of more than 5000 miles. Some one—a specialist—would have to be at the sending end who knew all about the special transmitting apparatus, who could set it up and repair it if something went wrong. He would have to know, too, how to link several relay stations.

"We'll send Alfred Koenig; he can handle the job," decided the officials, and sent him off to Honolulu with a photographer and the picture-transmitting apparatus.

The young expert met all expectations. He stopped in San Francisco and made the relay connection between the radio telegraph system, from Hawaii to San Francisco and the one from San Francisco to New York. After completing the system in Hawaii, he spent a day testing the relays. On the second day, photographs of the army and navy maneuvers

He Flashed Photos 5000 Miles through the Air

By Hyatt Gibson

at Honolulu were sent to New York in record-breaking time—a set of eight pictures in less than 20 minutes!

Photographs of the war games were relayed by wire and wireless over 5136 miles. They traveled 5012 miles by air in two wireless jumps, and the remaining 124 miles over telegraph relay wires. Since the test pictures were sent, photographs have been transmitted regularly over this great distance. The process takes from 10 to 20 minutes.

PHOTORADIOGRAMS, or wireless pictures, are believed to hold forth tremendous possibilities, especially in the field of military communication. A photograph of a message can be sent by wireless much more quickly than the message can be transmitted by changing words to symbols. By slightly altering the position of the carriage receiving a photograph sent by wireless, a garbled mass of dots and dashes travels through the air, totally unintelligible without a code.

Alfred Koenig will return to New York as soon as he has taught operators in Hawaii how to operate the photograph-transmission attachment. He will go back to the engineering laboratory and keep on at night school.

"You have to study like a house-on-fire," he explains, "to keep up with radio."

Manless Monsters to



Shoots 23 Miles

The most powerful long-range gun of its type, just perfected for the U. S. Army. It will throw a 1560-pound projectile a distance of 23 miles.

Where giant searchlights turn night into day. This spectacular demonstration of New York City's defenses against aerial attack was staged recently at Fort Totten, which guards the eastern approach of East River. Notice how powerful searchlight beams illuminate targets for anti-aircraft guns.

Huge Modern Weapons May Be Dwarfed by Appallingly Destructive Machines

By Truman Stevens

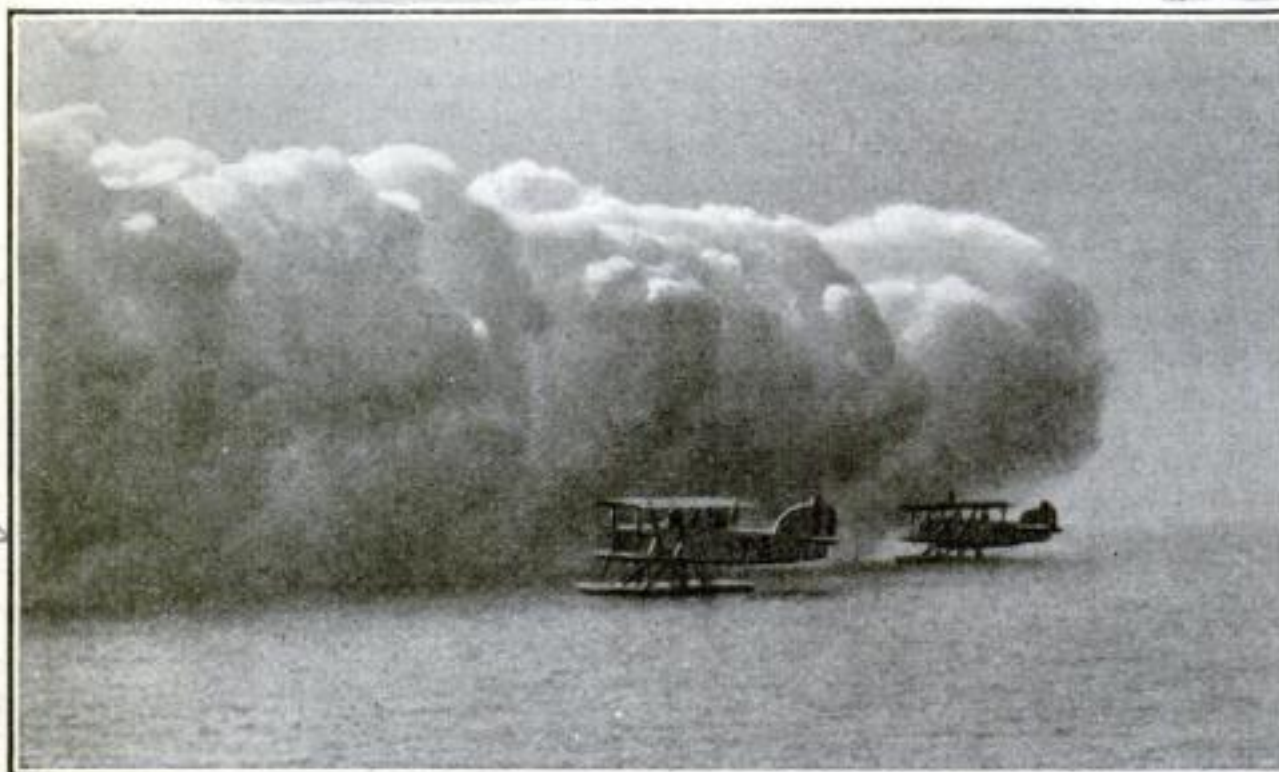
ON THESE pages are pictured a few of the marvelous new weapons of attack and defense developed by modern military genius. They represent the last word in war machines. Yet powerful and ingenious as these machines are, they would be helplessly ineffective beside the tremendous agencies of wholesale destruction predicted for the next great war, if such a war comes.

Scientists, inventors, and military men in active touch with the development of armaments practically are unanimous in the belief that a war of the future will be one of almost inconceivable annihilation. Death swifter than light, riding on waves of electricity and obedient to the will of master minds, they say, will blot out great cities, and even nations, almost in a breath.

One who has drawn a vivid picture of such a catastrophe is Professor A. M. Low of London, internationally known scientist and inventor, consultant to the British War Inventions Board during the World War.

The "no man's land" of future war, as he sees it, will be the sea, the undersea, and the air. There monstrous engines controlled by radio and obedient to human minds will strive to break through and destroy populated areas. Once the machines of either side break through with their deadly gases, chemicals, and explosives, the end will be only a matter of moments.

Radio control, radio communication,



Two of Uncle Sam's seaplanes hiding behind a thick smoke screen laid down by other planes at Bay Shore, Md. A screen hundreds of feet high and as impenetrable to human eyes as a brick wall, can be laid down by an airplane at the rate of a mile a minute by a new method developed by the U. S. Chemical Warfare Service. This means of concealment, it is believed, would be of tremendous aid to attacking planes during a naval engagement.

Decide Future War



Modern Tanks Proof against Bombs

Above is a spectacular demonstration of the effectiveness of modern tanks against bombs. The photograph was taken just as a bomb exploded among the First Division Tank Company during recent maneuvers at Miller Field, Staten Island, N. Y. At the right is a gigantic two-ton airplane bomb, 14 feet long. Compare its size with that of the soldier



and mastery of electric power will be deciding factors. Among the predicted weapons are: combined armored tank-submarine airplanes, for fighting on land, under water, or in the air; jets of water charged with electricity to kill off all life with which they come in contact; deadly gases and chemicals; battle planes developing wireless power to destroy aircraft within several miles; wireless fire to devastate enemy territory; wireless control of torpedoes, planes, ships, and submarines.

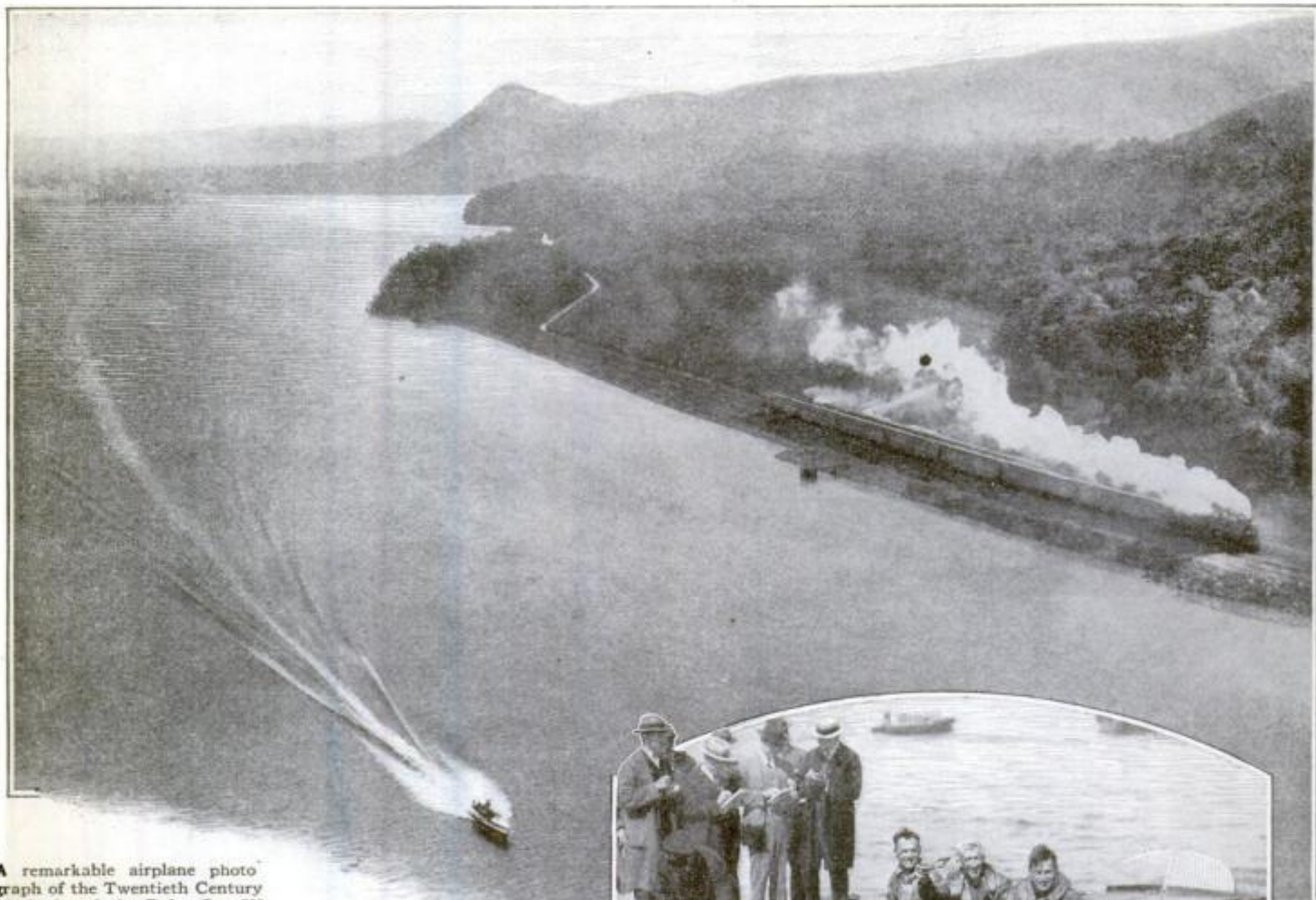
"The possibilities of electricity as a lethal weapon are almost unlimited," says Professor Low.

"Men will fight not with their bodies but with their minds. Their ingenuity will be directed toward supplying themselves with long-range weapons, responsive to exact control and capable of keeping at bay the lethal engines of the enemy equipped with facilities for the destruction of whole nations at a single blow."



How trees were crumpled like straws before the onslaught of tanks in recent mimic warfare at Miller Field, Staten Island. There 15 great tanks rumbled irresistibly over stone walls, trees, and ditches. This picture gives an idea of the tank's great power

A New Speed Rival of Plane and Auto



A remarkable airplane photograph of the Twentieth Century Limited and the Baby Gar IV in their dramatic 150-mile race down the Hudson. The speed-boat won the race by 24 minutes

©International News Reel

The Motor-Boat, Victor in Race with Express, Aims at 100-Mile Goal

By Ellsworth Bennett



The Victors at the Finish

The speed-boat Baby Gar IV tied up at the Columbia Yacht Club dock after beating the Twentieth Century Limited from Albany to New York. In the center is Gar Wood, owner and pilot. At his right is Olin Johnson, mechanic, and at his left, Charles F. Chapman, who acted as the official timekeeper

PRECISELY at eight minutes before seven the other morning the first section of the famous Twentieth Century Limited, one of the fastest trains in the world, rumbled across the New York Central Bridge at Albany, N. Y., for its daily trip down the Hudson River shore to New York City.

One minute later two high-powered motor-boats, the *Baby Gar IV* and the *Baby Gar V*, flashed out from a float almost directly beneath the bridge, and in furrows of flying spray, streaked down the river in pursuit.

The shades of Robert Fulton and of Henry Hudson must have stood aghast at the dramatic contest that followed. On the shore a streamer of smoke marked the swift passage of the Twentieth Century over the rails, while out in the river long ribbons of foam streamed back in the wake of the little speed-boats as they leaped across the waters.

And in the end one of the motor-boats won. After the *Baby Gar V* had broken down at Poughkeepsie, the *Baby Gar IV*, with its owner Gar Wood at the helm, completed the 150-mile journey to New York, 18 miles—24 minutes—ahead of the express. It made the trip in 2 hours, 48 minutes—an average of 45.5 miles an hour.

Some have said that it was no race at all—that the Twentieth Century starting from Albany 39 minutes ahead of schedule, was compelled to "loaf along" the river, bound to a schedule of safe operation. However that may be, the fact remains that this encounter passes into history as an epoch-making event. For by showing that it can leave behind one of the fastest trains on the rails, the power-boat definitely has won a place beside the airplane and the automobile in an era of speed.

Experts are predicting that the day is not far off when motor-boats will travel 100 miles an hour. The present world's record of 80 miles an hour is held by the *Miss America II*, one of Gar Wood's boats. Two of his boats have approached a 90-mile speed unofficially. And now, with the 100-mile goal in prospect, he has announced that he expects to build a boat with 2500 horsepower—one that literally will fly across the water.

Another sportsman who is aiming at the same goal is Alexander Johnson, a New York man, who now is building the *Yankee Doodle*, a speed-boat with four Liberty motors giving about 1800 horsepower.

A Country Schoolmaster Stirs the World

AS THIS issue of POPULAR SCIENCE MONTHLY is published, there is scheduled to take place in the little county seat of Dayton, Tenn., one of the most remarkable trials in the legal history of the last several centuries. John T. Scopes, teacher and football coach of the Rhea County High School in Dayton, is being prosecuted on a charge of teaching the theory of evolution in defiance of a state law, enacted last spring, which forbids any instructor in the public school system of Tennessee to "teach any theory that denies the story of Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals."

The specific charge against Scopes is that in reviewing in the classroom a textbook on biology—a book, by the way, regularly adopted and used in the schools of the state—certain portions were discussed by him in a manner that indicated his belief in the theory of evolution.

Scopes was arrested on complaint of George W. Rappleyea, an engineer of Dayton, himself said to be supporter of evolution and friendly to the teacher. The complainant's reason for causing the arrest and subsequent indictment of Scopes probably is made plain by the fact that before he acted he obtained from the American Civil Liberties Union assurance of financial backing in defense of Scopes, both in his trial in Rhea County and in the event the case is carried to higher courts.

THIS is the first time since the theory of evolution was promulgated by Charles Darwin 65 years ago, that the theory ever has served as the basis for a court case. Moreover, we must hark back for centuries before we find another case in which, as in the present one, the principal point of issue is a conflict between religious teaching and scientific opinion.

These are the circumstances that make the Scopes trial remarkable, that have focused the eyes of the world on an obscure little Southern town of 1800 inhabitants; these, and the fact that in the prosecution and defense are marshaled an array of legal talent and scientific experts such as might appear in the trial of a capital case involving persons of international notoriety.



The Storm Center

John T. Scopes, the young country schoolmaster of Dayton, Tenn., who goes on trial charged with teaching evolution in the Dayton high school in defiance of a state law. Some of the nation's most noted lawyers, including Clarence Darrow and Bainbridge Colby, former Secretary of State have gone to his defense.

For example, in addition to Judge John Randolph Neal, of Knoxville, Tenn., who is in charge of Scopes' defense, there are appearing for the defendant teacher, Clarence Darrow, one of the country's most noted lawyers, and Bainbridge Colby, former Secretary of State and law partner of Woodrow Wilson. Also, behind Scopes, ready to offer expert testimony in his behalf, is the entire membership of the American Association for the Advancement of Science, pledged to his support by Professor Michael I. Pupin, of Columbia University, president of the organization.

What the Tennessee Law Says

HERE is the main text of the law under which John T. Scopes is being prosecuted for teaching evolution in the high school of Dayton, Tennessee:

SECTION 1. Be It Enacted by the General Assembly of the State of Tennessee, That it shall be unlawful for any teacher in any of the universities, normals, and all other public schools of the state which are supported in whole or in part by the public school funds of the state, to teach any theory that denies the story of the Divine Creation of man as taught in the Bible, and to teach instead that man has descended from a lower order of animals.

SECTION 2. Be It Further Enacted, That any teacher found guilty of the violation of this act, shall be guilty of a misdemeanor and upon conviction shall be fined not less than one hundred (\$100) dollars nor more than five hundred (\$500) dollars for each offense.

Great Legal Battle Looms in Trial of John T. Scopes for Teaching Evolution

By Robert E. Martin

On the other side, arrayed with the prosecution, is William Jennings Bryan, the country's best known antagonist of evolution.

Now, what is it that has caused these well-known men to enter actively into a legal case wherein a small-town school-teacher has found himself in difficulties due to his alleged disobedience of a state school statute? What is it that has caused what, on the face of it would seem a matter of local interest only, to assume the proportions of a national issue?

According to Judge Neal, chief counsel for the defense, the question of the truth or falsity of the theory of evolution is not the issue at stake. The question to be decided, he declares, is whether freedom in teaching and learning what the great thinkers of the ages have worked out is to be maintained or denied. As such, he declares, the principles involved in the Scopes case assume tremendous importance.

WILLIAM JENNINGS BRYAN, on the other hand, maintains with the prosecution that it is the Darwinian theory that is on trial; that the question to be settled is whether the Bible or Darwin is to be accepted as truth in explaining the mystery of creation.

To many persons mention of the theory of evolution probably conveys no idea more definite than that the evolutionists hold that man is in some way or other descended from the monkeys.

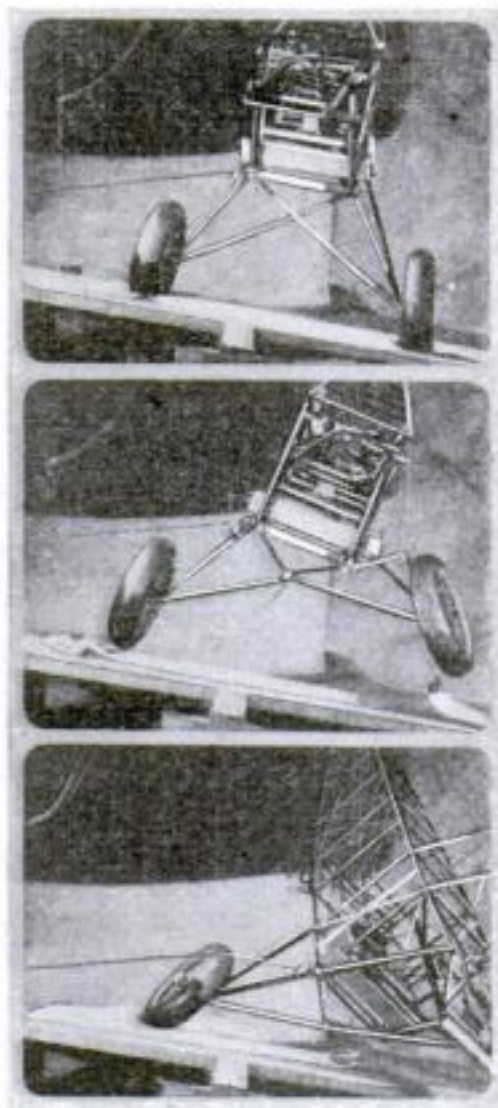
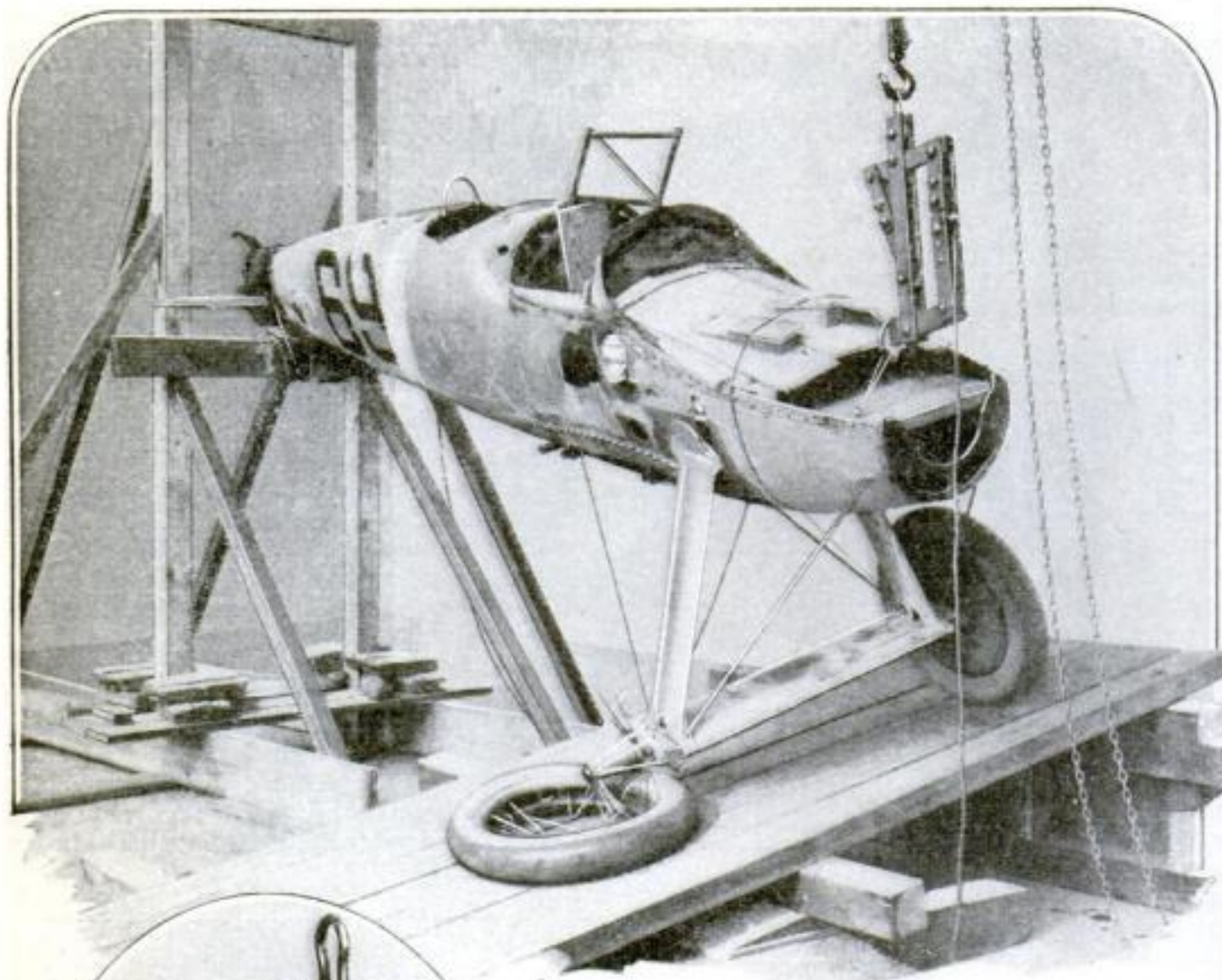
As a matter of fact, no evolutionist—not even Darwin himself—has held this opinion. The belief offered in 1844 by Darwin, Sir Charles Lyell, Alfred Russell Wallace, and several other British scientists, was that study of various biological, fossil, and other data, collected by them, indicated that reptiles were developed from fish, and birds from reptiles; that all nature develops in an orderly way, everything moving from a simple to a complex state.

That is, instead of each of thousands of kinds of animals, insects, birds, fish, and reptiles being made separately, they came into being through gradual changes. In his book, "The Origin of Species," Darwin described a process he termed "natural selection," which might explain this development, pointing out how accidents, disease, starvation, and other factors weeded out the weak in every kind of plant and animal. Thus, only the fittest were left to produce new generations each year,

(Continued on page 114)

When Airplane Landing-Gears Crash

Machines Dropped in New Safety Tests—By E. F. Bacon



Where the Break Came

Failure of the landing gear is seen clearly in these pictures of the test. In the second picture the fracture of a strut is visible. The second and third views show the rebound of the machine and collapse of the landing gear.

How the Test Is Made

An actual test with the new apparatus, showing collapse of the landing gear. The nose of the fuselage is lifted by block and chain and dropped from increasing heights, varying from 12 to 40 inches until failure finally occurs.

means partial or total wreck of the plane.

To determine exactly the ability of landing gears to stand up under various loads and thrusts, the Engineering Division of the U. S. Army Air Service recently standardized the testing methods pictured on this page. The airplane to be tested is stripped to the fuselage, then loaded with bags of shot representing the weights of motor, wings, and equipment.

With the tail of the machine supported on a scaffolding, the nose is lifted vertically by a block and chain until it reaches a certain height. Then, by means of a trigger release hook, it is dropped suddenly on an inclined platform designed to simulate a cross-wind landing. In this manner the fuselage is dropped successively from increasing heights until failure occurs. The drop varies from 12 to 40 inches, according to the type of plane. To determine accurately the live loads at which failure oc-

curs, and to obtain comparative data on shock-absorbing systems, a shock-recording instrument was designed. This consists of a pair of circular plates with holes, through which a set of spindles, fitted with needle points at their lower end, is free to slide. The movement of each spindle is governed by weights placed on top of the spindle and by an adjustable coil spring that fits loosely around it and is fastened to a collar locked to the spindle.

Clamped to the lower plate is a circular recording paper. The record of a shock is made by small holes that are pricked in this paper by the points of the spindles as they plunge downward in response to an impact. Since, by varying the compression of the spring, each spindle can be set to record a definite acceleration of gravity, location of the pin pricks on the record tell the story of the shock to which the landing gear is subjected and valuable data are obtained.

The Shock-Recorder

Shocks to which the landing gear is subjected are recorded by pin pricks made by a series of sliding spindles, governed by adjustable springs and weights, which are shown above.

WITH the continued increase in flying speeds, and consequent increase in landing speeds, the problem of safety in landing is one that is engaging the best efforts of aeronautical engineers.

Safe landing depends not only on the skill of the pilot, but on the strength of the airplane's structure. Even the most expert pilot is unable to prevent rough landings under adverse conditions. A forced landing on rough ground, a sudden gust of wind at the moment of landing, or a quick swerve to avoid an obstacle, may cause violent stresses on the landing gear. Structural failure under such conditions

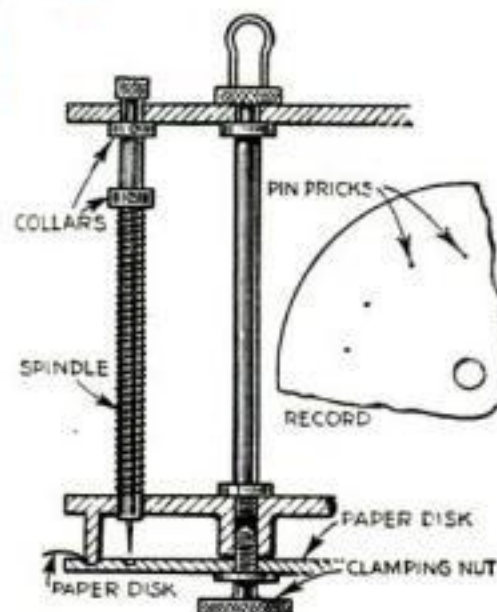


Diagram showing construction of the shock-recorder. The position of pin pricks on a paper record registers the amount of shock to the landing gear.



Here are the three judges who will award the prizes in POPULAR SCIENCE MONTHLY'S \$10,000 "What's Wrong" Contest, at work examining entries. From left to right they are: Alexander Senauke, M.E., E.E.; Prof. Collins P. Bliss, and Dr. Hazen G. Tyler

You Still Have Time to Win in Our Great \$10,000 Prize Contest

ARE you observant? Are you alert? If you are, here is an opportunity to win one or more cash prizes in our \$10,000 "What's Wrong" picture contest. As you probably know, the contest was announced in our June issue, but with 512 awards yet to be made, there is still a chance for everybody.

You can start now. The idea is simple. It has to do with John and Mary Newlywed and their enthusiastic but inexperienced efforts to do odd jobs about the house. Eight pictures are published each month. Each shows something wrong in the way a job is being done, and in addition, the artist has drawn one thing in each picture incorrectly. What you are to do is to find the mistake the artist has made and also tell what John or Mary is doing wrong and why it is wrong.

You will find the contest fascinating and profitable. It costs nothing to enter. It is open to every one, everywhere. Members of your family and your friends all can take part in it. And you can submit as many sets of answers as you like. Remember, you have until July 30 to submit your answers for the pictures published in our July issue and until August 30 to solve this month's puzzles.

Take the first picture in the August contest on the next page, for example. There John is seen hanging a screen door. What is it that he is doing wrong? What error has the artist made? Study the picture carefully, then answer these questions briefly and clearly.

A number of contestants have written us asking whether they are allowed to send in more than

one set of answers to any picture, and if so, how answers should be submitted. The rules of the contest, which appear on page 110 of this issue, state that contestants may submit as many answers as they wish for pictures in either the Monthly Contests or in the Grand Prize Contest, provided they are submitted in good faith. Additional answers for any picture, however, should be sent in

as separate entries. In other words, you can submit as many different sets of answers for the pictures as you wish.

In cases where an individual submits more than one set of answers, the judges, in considering awards, will select the set of answers that is most nearly correct.

The three judges who will decide on all awards are shown in the photograph at the top of this page. They are:

Prof. Collins P. Bliss, Director of the Popular Science Institute of Standards and head of the Department of Mechanical Engineering at New York University; Dr. Hazen G. Tyler, Associate Director of the Popular Science Institute of Standards and Associate Professor in charge of Experimental Engineering, New York University; Alexander Senauke, M.E., E.E., Radio Engineer of the Popular Science Institute of Standards. The decisions of these judges will be final.

The third set of pictures, comprising this month's contest, appear on the two following pages. If you have misplaced your copies of the June and July issues of POPULAR SCIENCE MONTHLY containing the first two sets of pictures, copies of these issues may be examined free at the offices of this magazine or at public libraries. Or, if you wish, you may obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.

The fourth and final set of contest pictures will be published next month. Watch for the September number, on the newsstands August 10.

You May Win One or More of These Big Prizes

POPULAR SCIENCE MONTHLY is awarding \$10,000 in 580 cash prizes for the best answers submitted in this great contest. The cash prizes in each of the four monthly contests are:

First Prize.....	\$500
Second Prize.....	\$100
Third Prize.....	\$50
5 Prizes, \$10 each.....	\$50
60 Prizes, \$5 each.....	\$300
Total, four months.....	\$4000

In addition, cash prizes in the Grand Contest will be paid as follows:

First Grand Prize.....	\$2500
Second Grand Prize.....	\$1000
Third Grand Prize.....	\$500
5 Grand Prizes, \$50 each...	\$250
50 Grand Prizes, \$10 each...	\$500
250 Grand Prizes, \$5 each...	\$1250
Total Grand Prizes.....	\$6000

COMPLETE RULES FOR THIS SENSATIONAL "WHAT'S WRONG" CONTEST ON PAGE 110

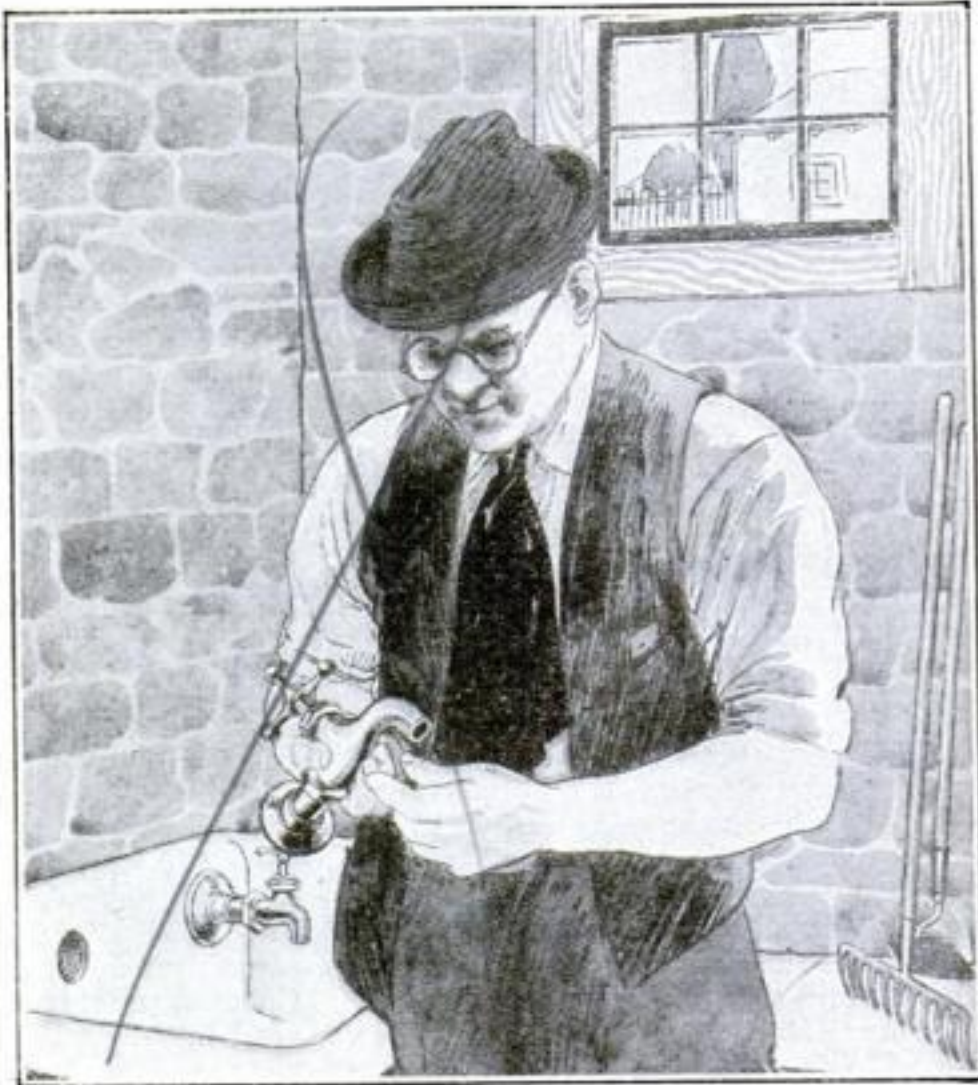
A \$10,000 Test of Observation and Alertness

What's Wrong in

In Each John Is Doing Something
Made One Error



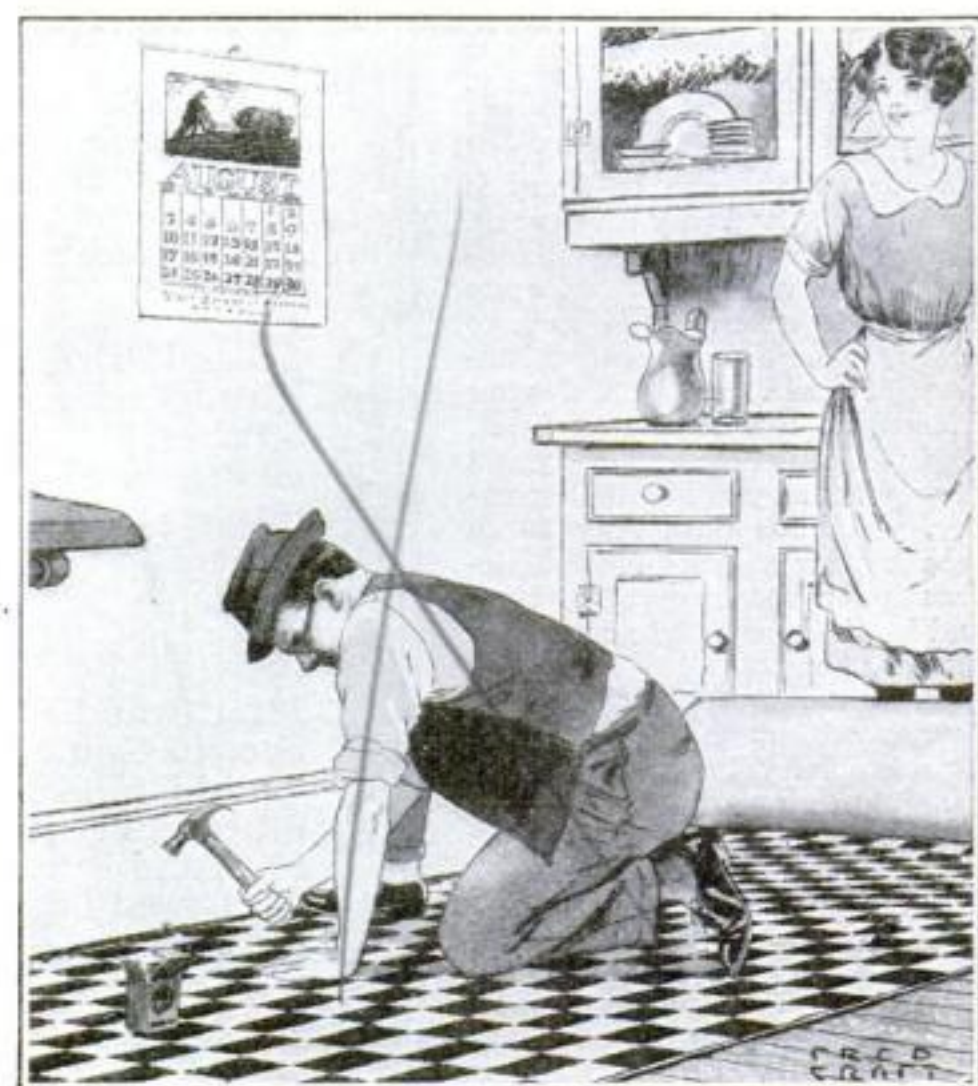
1. When a high wind tears off the old back screen door, the Newlyweds decide to get a new one. Fitting the door is a job that John undertakes with more relish than experience



2. Mary complains that the compression faucet in the washtub leaks. John says a new washer is needed, and is delighted to try his hand at such a simple plumbing job



3. With Mary steadying the board, John finds double enjoyment in nailing up a shelf in the bedroom closet, even though he is not quite sure how it should be done

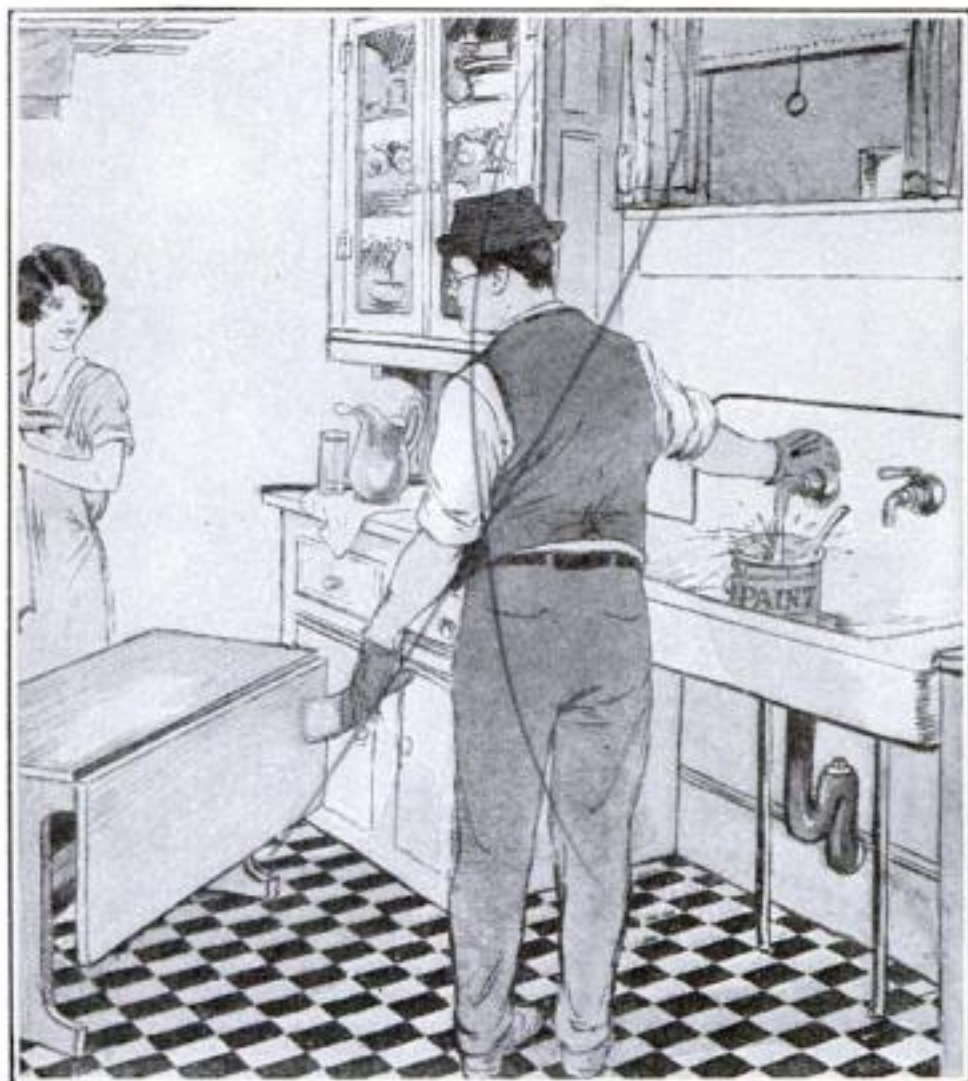


4. New linoleum for the kitchen floor arrives and John enthusiastically sets to work to lay it. Here he is tacking down the first width, while Mary watches from the side lines

These Pictures?

Wrong, and in Each the Artist Has
in the Drawing

*Read the Rules
of This Amazing
Contest—Page 110*



5. Mary superintends while John paints the drop-leaf table. When he finds the paint too thick to spread properly, he gladly adopts her suggestion for an easy way of thinning it



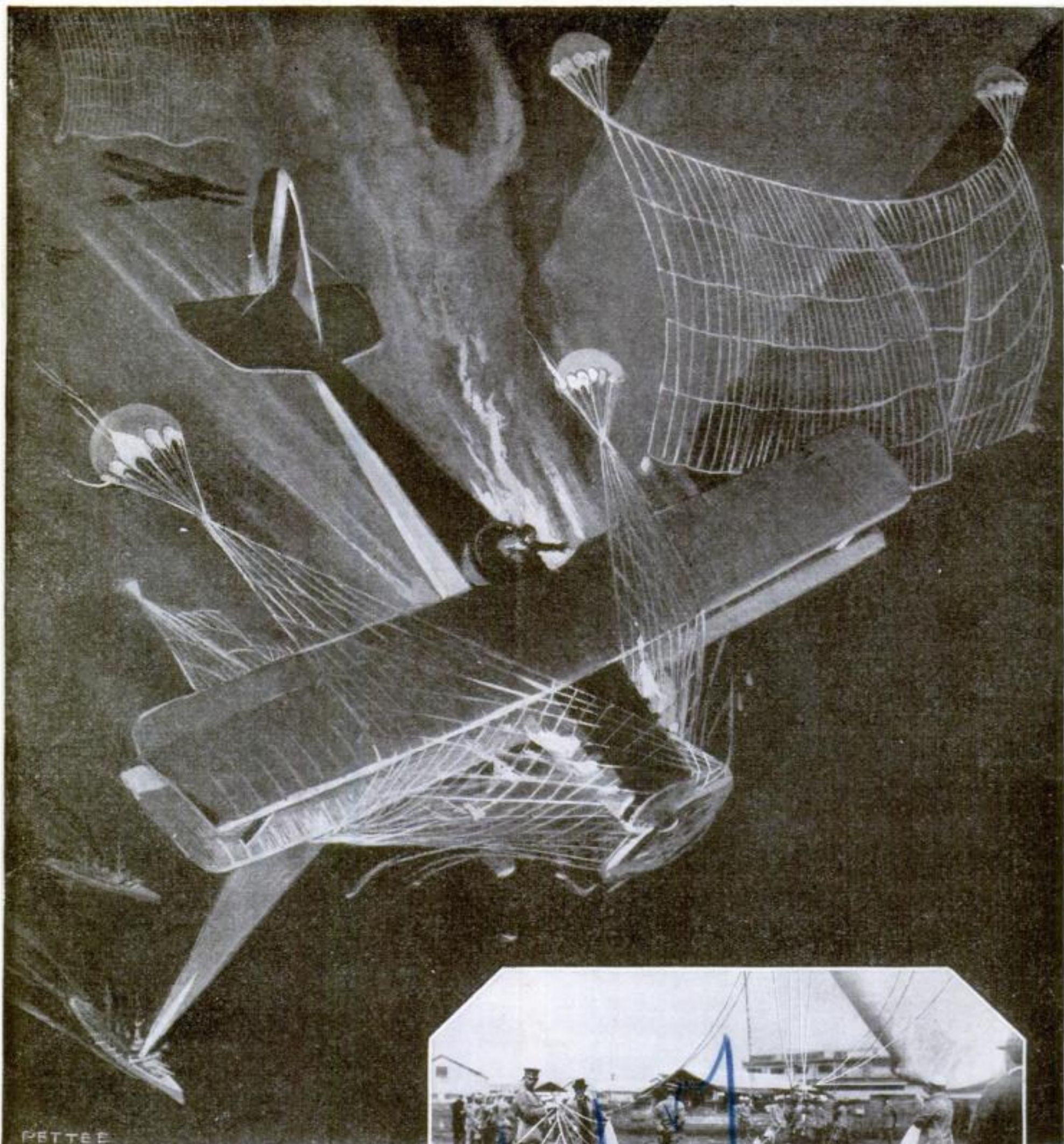
6. One of the dining-room windows refuses to stay up. This gives John his first experience in removing the window stop and replacing a broken sash cord with a new one



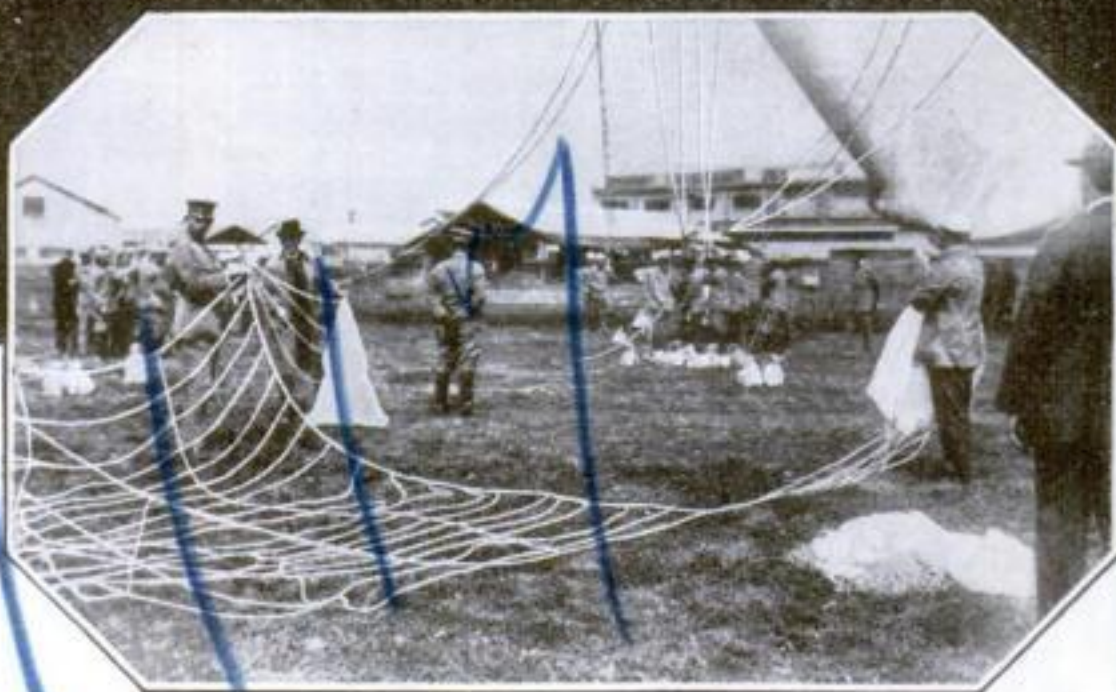
7. The engine of the Newlywed's coupé starts to miss—an excuse for John to tinker with the spark plugs. Here he is shown adjusting the points, using a half dollar as a gage



8. Although a novice, John determines to repair some ugly breaks in the cellar floor. Here he is storing the cement behind the garage until he can find time for the job



A Thrilling Haul! Sky Nets to Capture Planes



FISHING-NETS of the sky, designed to catch enemy airplanes, form one of the latest and most spectacular developments in anti-aircraft defense. Devised by a Japanese inventor, Takeo Takagi, they now are being tested by the Japanese army and navy.

Fastened between parachutes, the

nets are shot upward in bombs. When the bombs burst high in the air, the parachutes open, spreading the nets in the path of enemy airplanes.

Here our artist presents a dramatic picture of how the net is designed to foul the propeller. The lower picture shows a net on the ground with parachutes attached.

What's Wanted from Inventors

*Here Is a Remarkable Record
of Hundreds of Opportunities
for Your Constructive Genius*

By Clair Price

DEMANDS of all sorts upon the ingenuity of inventors are contained in a red-bound memorandum book that lies in the members' room of a suite of offices in London, England, occupied by a patentees' mutual aid organization. Although it embodies an idea as unusual as it is useful, the book is as commonplace in its outer appearance as an ordinary ledger. Only the gilt letters of its title, "What's Wanted," indicate to the casual visitor that its contents are far from commonplace.

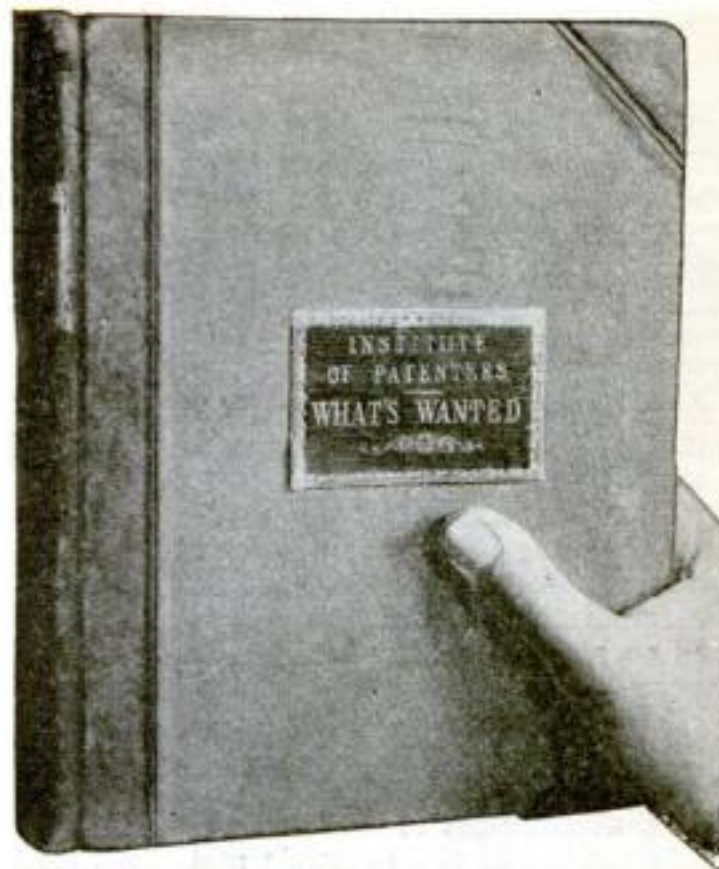
Manufacturers, scientists, research workers, members of the British Parliament, housewives, and the plain man in the street have written their wants in it. London inventors have formed the habit of consulting it in search of ideas for commercially promising inventions. As a result "What's Wanted" presents a remarkable view of the wide scope of present-day inventive science, for the demands made through this unique book vary from a method of utilizing atomic energy to such humble wants as an effective means of rooting up dandelions from the lawn.

IN SOME of these wants there are decades of work for laboratories with the most advanced and complete equipment. In others, no more is needed than the flash of a new idea and a pair of ordinary, capable hands to carry them out. Some of them are far beyond the resources of the average inventor. Others are suited to the humbler wits of any of us, whether we are inventors or not. For the product of the man who can meet any of them there is a real demand, else they would not have found their way into the pages of "What's Wanted."

There is money waiting for the inventor who can cope with any of these wants. In the case of a few of them—the harnessing of the sun's electromagnetic waves, for instance—there are millions awaiting the successful inventor and a position in history possibly greater than that of the man who first harnessed steam.

In the case of others—for instance, a pipe that can be cleaned easily and effectively—a comfortable little sum is waiting.

All of them, from the demands whose fulfilment would revolutionize industry down to the humbler wants of the man in the street, may be found jumbled together in the crowded pages of "What's Wanted." If brevity is the soul of wit, there are few pages more



This is the most remarkable memorandum book in the world, its pages filled with needed inventions

under the heading of electricity and wireless. This is no doubt a correct reflection of our industrial civilization in this year of grace, 1925.

What Britain wants from her inventors is, first, improvements in the young science of wireless; second, domestic and general household improvements and, third, improvements in internal-combustion engines, new sources of power, and new methods of power transmission. To a lesser degree, the English people are interested in nautical, chemical, and phonetic improvements.

LASTLY, there are improvements wanted in the realms of the airplane, office methods, lighting, heating, and metallurgy. This, it might be emphasized, is the order in which England is making its demands upon the ingenuity of its inventors. A list of similar American wants might vary the order somewhat, for labor-saving devices of the domestic and general household sort are more advanced in the United States than in England.

These, according to "What's Wanted," are some of the improvements that Great Britain is asking of her inventors in the realm of electricity and wireless:

A means of transmitting wireless power of sufficient capacity for transforming into mechanical energy.

An efficient method of varying radio oscillation frequencies over an almost unlimited range.

A loudspeaker that is controllable without distortion.

Improved methods of electrical storage and power transmission.

A loudspeaker free from the "phonograph effect."

What Would You Like to Have Invented?

DOESN'T it strike you that the "What's Wanted" book described by Mr. Price in this article is a great idea?

That's just the way it strikes us. And so we are going to copy the idea. We are going to compile an American "What's Wanted" book.

This book we will place on a table in the home of POPULAR SCIENCE MONTHLY at 250 Fourth Avenue, New York City. There it will remain always open for anybody to enter his wants in black and white. There, too, it will be open to inventors everywhere, who come to it for suggestion and inspiration.

If you live at a distance and have a want to enter, simply mail it and we will enter it for you.

Already we have a most interesting nucleus for our book; for on its first pages we are entering needed inventions suggested in letters from a number of interesting persons, among them Houdini, the world famous man of magic; George Gordon Battle, noted New York attorney, and Dr. David Starr Jordan, chancellor emeritus of Leland Stanford, Jr., University.

Can't you imagine the fascinating possibilities that such a volume holds? Any day—who knows?—an idea caught at random from its pages may lead to an invention which, like the steam-engine and the automobile, may transform the very world we live in.—THE EDITOR.

packed with wit, more abruptly eloquent, than the scribbled pages of this unique volume.

If we attempt to straighten out its jumbled miscellany into some sort of order, to classify its hundreds of wants under general headings, it will be found that the largest number of them fall

Elimination and control of atmospherics.
Wireless television.

More selective methods of reception.
Elimination of voice distortion in wireless receivers, amplifiers, and telephones.

A receiving valve (vacuum tube), the effective anode-filament resistance of which is about 1000 ohms.

SHARPLY directive reception from only one fixed direction with possibility of altering direction at will.

Neutralization of internal capacity coupling inherent in triode valves.

More knowledge of the effects and constitution of the heavy side layer.

The true theory of crystal rectification.

A long-life dull emitter filament.

A different class of inventor will be interested in the domestic and general household wants that are sprinkled through the pages of "What's Wanted."

A key that will not lose its identification.



A Page of Entries

Above: Entries written in "What's Wanted," by Prof. A. M. Low, distinguished British scientist. Left: Capt. C. Drury Coleman, secretary of the Institute of Patentees, entering letters

A light, efficient, slow-speed internal-combustion engine.

An internal-combustion turbine.

(a) Wind turbine electro plant. (b) Water turbine electro plant. (c) Crude-oil engines for use in tractors and road vehicles.

A method of reducing friction.

A practical method of making use of the power of the tides.

easily managed either by a boy or a girl.

A method of conveying speech directly and readably to paper.

The discovery of the mechanism that enables us to remember almost instantly in our brains without going through the mechanism of the card index and equivalent systems.

A furnace that will conserve 95 per cent of heat.

A heat insulator, having as nearly as possible the strength of metal, which can be screwed and turned like metal and which, while insulating the heat of one from the other, will make a perfectly strong and reliable connection between two pieces of metal. The insulation must stand up to both dry and wet heat.

Motor headlight that satisfactorily lights the road surface without "dazzling" approaching drivers.

Some form of lighting appliance capable of penetrating fog.

A method of eliminating rust.

An alloy, ferrous or non-ferrous, possessing 50 per cent to 100 per cent higher tenacity than a known alloy without being brittle.

A glass that will bend.

A means of inducing and preventing rain.

More knowledge of the translation of mechanical power into musical tone.

Credit for first suggesting the usefulness of "What's Wanted" belongs to Sir William Bill, whose short, silver-haired figure has been one of the fixtures of the House of Commons for the last 25 years.

Less than two weeks after Sir William's suggestion was made, the book itself was placed in the members' room of the Institute of Patentees. "What's Wanted" then contained a title page, Sir William's preface, a letter from H. G. Wells, and a list of 15 wants that its donor had mentioned at the Institute's annual dinner. The rest of its 200 pages were empty and waiting, but its donor's idea soon took hold.

Professor A. M. Low, a distinguished British scientist, was one of its earliest contributors and the list of 29 wants that he has committed to it is even now the longest single list it contains. Other contributors soon followed, most of them individuals, a few of them corporations. Thus far the British Broadcasting Company is the largest contributor among British corporations, and most of the wireless wants appear above "B.B.C."

THE mails began bringing in wants to be copied into it. Individuals began climbing the two flights of stairs at 44 Great Russell Street, opposite the massive time-blackened front of the British Museum, to write their wants in it. Most of these persons are Londoners, but an increasing proportion are foreigners.

The Institute is a mutual association through which inventors supply themselves with technical, legal, and commercial advice in the development and marketing of their work, but "What's Wanted" is open to anybody, member or non-member, who knows of a specific demand worth an inventor's attention.

A pipe that can be cleaned easily.

A temperance drink that will keep and yet not pall on the palate.

A means of removing old paint.

Greatly simplified clothing, not strange in appearance.

A cheap house-warmer that can be fitted by any one.

A plan by which house refuse can be easily and cheaply destroyed at home.

A COOKING range that is efficient, i. e., that usefully applies a reasonably large percentage of the heat of combustion of the fuel supplied.

A fire grate giving the open-fire effect without wasting the major part of the fuel consumed.

An electric toaster that will, if possible, cut off the current just before the toast begins to burn, or, if that is not possible, that will give some audible indication in time to avoid spoiling the toast.

A tie presser and stretcher for men's ties, which will take at least 20 ties at a time.

A dandelion extractor.

Under the heading of internal-combustion engines, new sources of power, and new methods of power transmission, there is work for the most brilliant and best equipped inventors:

A motor engine of one pound weight per horsepower.

Harnessing the sun's electromagnetic waves.

A method of utilizing atomic energy.

Inventors of all degrees of achievement and equipment will find attractive ideas in a few of the other demands that are voiced in the pages of "What's Wanted."

Means whereby a ship's officers can inform themselves of the position and movement of approaching ships and so avoid collisions.

Improved ships' davits.

A safe method of stopping ships from rolling, or at any rate not more than a few degrees in the roughest weather.

A process for instantaneous color photography.

A chemical thermostat that will operate as efficiently and permanently as the thermostat that keeps the human blood temperature at approximately 99° F. and the blood of other animals at various temperatures.

Refractory materials for lining steel melting furnaces and ladles that would be absolutely unattracted by erosion of the molten metal or corrosion of the various metallic oxides formed during the steel melting process.

A noiseless gun.

A motion-picture film that will speak.

Non-resonant telephones.

A noiseless airplane.

An airplane that can be safely and

Astonishing Things an Expert Has Learned About YOUR JEWELS

as told by
R. Clifford Black
to **Newton Burke**

MOST New-Yorkers of the last quarter century remember the late "Diamond Jim" Brady, one of the most advertised men of his time. Newspapers and many periodicals had articles about his jewels and his love of the theater, and through them he was known throughout the United States. Literally ablaze with jewels, this eccentric business man sat in the front row at every theatrical first night. He had 44 complete sets of jewelry, mostly diamonds. These included even diamond buttons for his underwear.

The most unique of his jewels was what he called his "transportation set." He used to wear this to railroad directors' meetings. The pieces were of platinum studded with diamonds. The shirt-studs were in the form of a bicycle, an auto, an airplane, and a buffalo, each 1½ inches long. His watch chain was made of interlocking wheels each set with diamonds. One cuff-link set was a diamond tank car and a coal car; a second set was a freight car and a passenger car, each two inches long.

His leather pocket-book was ornamented with enormous initials of diamond mermaids and dolphins. His eye-glass case was a huge locomotive set with diamonds. A big belt-buckle consisted of a wheel flanked by two tigers. The ornament of his finger ring was a wheel 1⅓ inches in diameter. In the center was an enormous blue diamond which, although not one of the largest in existence, was one of the most valuable because of its beautiful color.

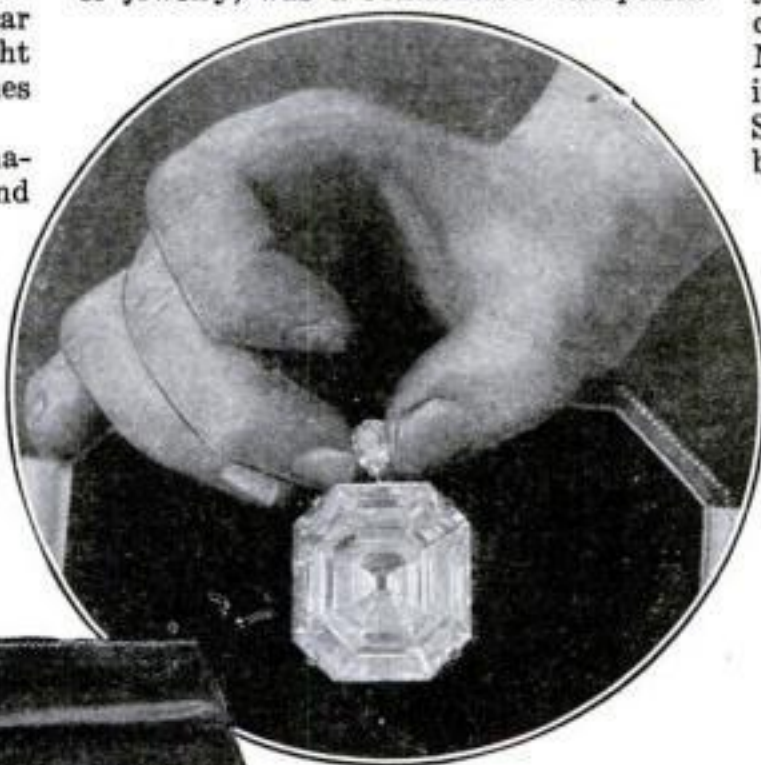


Peeling a Pearl to Expose Its Hidden Beauties

A pearl is formed in layers and when outer layers are poor in color or damaged, they may be peeled off until a beautiful inner layer is revealed. Here is William Herries, American pearl expert, peeling a pearl. Mr. Black, sponsor for this article, who is an international authority on jewels, points out that this is one of the most delicate tasks in the world, since there is a chance of ruining the pearl in the process. Only four men in the United States can do it successfully.

His diamond tie-clasp was in the shape of a camel. He used a lead-pencil of solid platinum set with diamonds. The watch had a wheel design set in diamonds. The whole of the unique set weighed five pounds.

But "Diamond Jim," with his pounds of jewelry, was a remarkable exception.



The World's Largest Blue Diamond

Here is the largest blue diamond ever discovered, brought to the United States by Black, Starr and Frost, the well known New York jewelers. It weighs 127 carats, and is said to be a perfect stone.

Most men care little for gems. Give a man a watch and he is well satisfied. His wife can display the family jewels. Of the \$450,000,000 spent for gems by Americans yearly, about 95 per cent is for the adornment of women.

Women always have liked jewels. Did you notice newspaper accounts of the excavation of Kish recently by the Field Museum-Oxford University expedition in Mesopotamia? Kish was the colossal Sumerian capital that flourished 3000 years before Christ, long before civilization in Egypt. The Chicago excavators discovered a magnificent palace, and in the boudoirs of the court ladies were quantities of ornaments decorated with the same stones that we consider precious today.

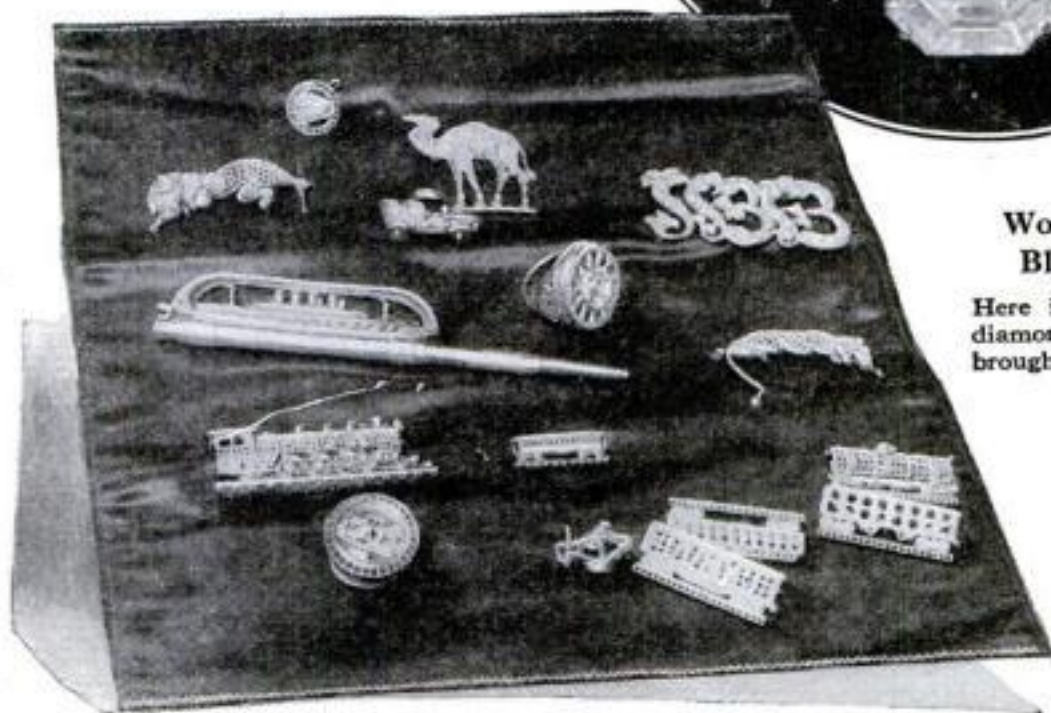
JUST what causes people to attach tremendous value to bits of stone is one of the mysteries of human nature. Money has changed during the centuries, but the value of jewels has remained fairly constant. In times of uncertainty fortunes are saved by converting money into jewels.

A dealer came to me two years ago and said, "Mr. Black, I have a lot of emeralds here that I can sell cheaper than any one else." I asked him where he got the gems, and he told the following story:

During the war the gem miners in the Ural Mountains in Russia were unable to dispose of their jewels. A Russian emerald cutter foresaw the revolution that was coming and bought right and left of emeralds. He purchased a freight car, and had it fitted up with comforts. When the revolution started, he and his family began traveling in this freight car across Siberia.

He hollowed out a log that lay by the stove in his car and into this put all of his emeralds. As he was known to be a man of money, the Bolsheviks searched the car

(Continued on page 112)



"Diamond Jim's" Remarkable Set of Jewels

Part of the amazing "transportation set" of jewels worn by "Diamond Jim" Brady, New York financier, when he attended railway directors' meetings. They are of platinum studded with diamonds, and each piece represents some method of transportation.

Digging through the Ages for



Across the Desert Wastes

Part of Count de Prorok's expedition crossing the Sahara in a six-wheel motor-car in search of long-forgotten towns buried in the desert

Scientists Search the Shifting Sahara Sands for the Key to the World's Most Alluring Mystery

By Edgar C. Wheeler

Sifting Traces of Prehistoric Man

Count Byron Kuhn de Prorok, leader of the Franco-American expedition in northern Africa, sifting for prehistoric flints in the river-bed of Oued El Abied. In the desert wastes he seeks to uncover the buried remnants of a lost continent

FROM long forgotten towns buried under the sands of the Sahara, and from other towns believed to have been submerged in the sea for untold ages, scientists today are at work to patch together bits of fascinating history which, they hope, may at last give an answer to the world's greatest mystery—the legend of the Lost Continent of Atlantis.

Over trackless desert wastes of Tunis and Algiers, and along the historic African shores of the Mediterranean, a Franco-American expedition of archeologists, under the leadership of Count Byron Kuhn de Prorok, has been following a trail of dead and buried cities that flourished thousands of years ago. This trail, they hope, may lead them to the discovery of the birthplace of civilization, a "vanished continent" from which emerged the culture of the ancient Egyptians and Phoenicians, and which cradled a mighty race of people.

This remarkable scientific adventure

promises to become one of the most romantic gambles in archeology ever undertaken. That it will abound in fascinating mystery and rich discovery already is indicated by the most recent reports of the expedition from Djerba Island in Tunisia. In the rushing tides of a narrow channel that separates this classic "Island of the Lotus Eaters" from the mainland, deep-sea divers under the direction of Count de Prorok have begun the search for a mysterious ancient city believed to have been engulfed centuries ago by the Mediterranean. The search is based on statements of native sponge-divers, who say they have watched the fishes playing among fantastic ruins of the city 50 feet under water and have seen houses with walls 15 feet high, intact stairways, streets, and many-colored columns.

A swift tidal current running through the channel thwarted the first attempts of two professional divers.

Later, however, six divers exploring different parts of the channel all reported seeing much pottery, most of it solidly incrusting in the bed of the sea. They brought up 14 fragments, several of which

are 15 inches long, with mouths and handles intact, forming parts of large urns. All were covered with beautiful marine growths. How ancient this pottery is remains to be determined. Meanwhile the hazardous diving operations are continuing.

EVEN more alluring, perhaps, is the ultimate goal of the explorers—a mysterious hill-bordered tableland known as the Hoggar Plateau, lying 1000 miles across the desert in an almost inaccessible spur of the Atlas Mountains. Because of its unusual formation, this unexplored plateau long has been associated with Plato's fabled description of Atlantis, where dwelt a race of supermen who gave to the world the arts of civilization before the continent was swallowed up "in a day and a night" by the waters of the ocean.

Count de Prorok is staking his hopes on the theory that the desolate Hoggar Plateau is the remnant of the submerged continent. He believes it possible that here man first emerged from barbarism, and that colonists who went out from here eventually formed the ancient Egyptian civilization. He hopes, too, to find here a definite answer to the question whether prehistoric men, whose remains

the Lost Atlantis

have been discovered in France, came, as some scholars believe, from Africa before the sea filled the Mediterranean basin.

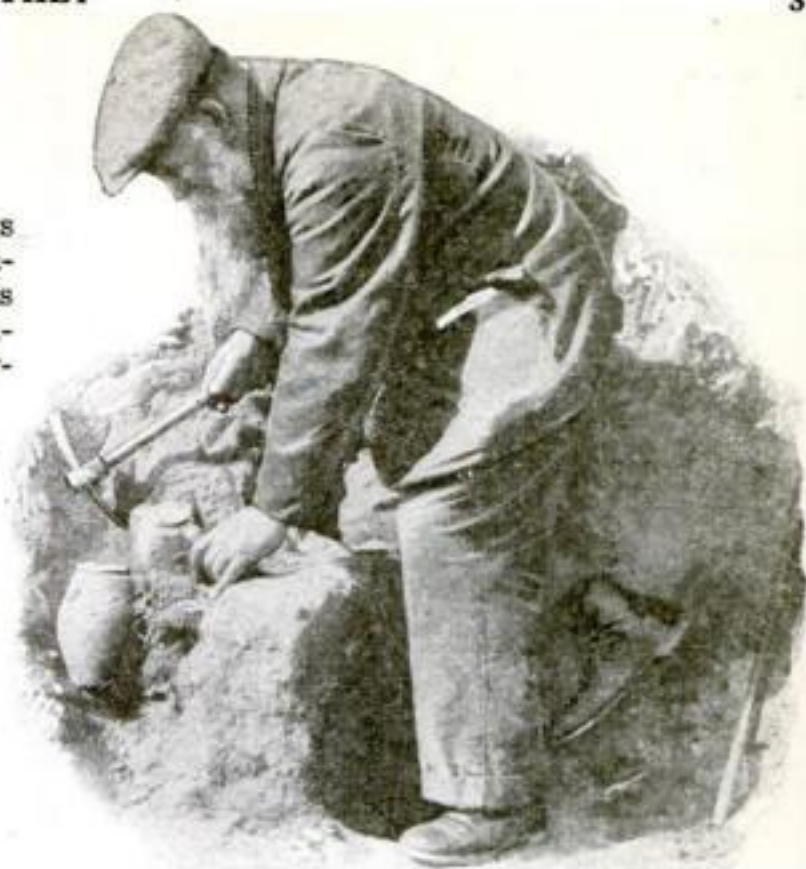
May it not be possible that the same deluge that engulfed the supposed submerged city at Djerba also swept the land that is now the great desert to the south, and that the sand of the Sahara once was the floor of a sea? And before the floods came, may not this same Sahara have been part of the lost Atlantis? May not the waters have receded after their destruction, leaving the bleak tableland of Hoggar rising from a sea of sand?

NOT many years ago such an expedition would have been regarded almost as an absurdity. Then the story of Atlantis, handed down through the centuries, was regarded as a myth.

Today, however, science has learned that in the alluring legends of the ancients lies a vast storehouse of knowledge. Just as the "myths" of Troy and the Tower of Babel have been revealed as realities, so now we are quite sure that the tradition of the Deluge was more than a fable.

Science tells us that 10,000 years ago, or perhaps 30,000 years, this great catastrophe overtook the world. Just at a time when the first true men were fashioning the beginnings of civilization, the Atlantic Ocean leaped its banks and engulfed them. Swollen through the years by melting ice sheets of the last Glacial Age, the mighty waters tore through the hills at Gibraltar and poured down upon those primitive people, destroying their settlements, burying the fields they had learned to cultivate, and finally rising through the valleys until the waves lapped the mountain cliffs.

And then, thousands of years later, perhaps six or seven thousand years ago, after the waters had receded, we find a brown-skinned people establishing parallel civilizations in fertile lands close to the shores of the inland sea—the Mediterranean. We find the Sumerians in Mesopotamia, in the valley of the Tigris and Euphrates, and the Egyptians in the valley of the Nile. And, what is strangest of all, we find traces of the same sort of people and the same sort of culture, distributed in far separated lands—in India, China, Central America, Mexico, and even in England. Distinguishing this culture are certain common



Unearths Ancient Urns from Carthage

Abbé Chabot, noted archeologist and authority on Phoenician inscriptions, digging ancient Punic urns in Carthage



Where Men Roamed before the Dawn of History

Members of the de Prorok expedition passing on horseback through the gorges of Seldja, Tunisia, where prehistoric flints already have been found in the bed of a river flowing through the magnificent gorge



A North African Ferry

One of the expedition's cars riding on an Arab dhow near Djerba Island, where the expedition is searching for a sunken city submerged in the Mediterranean

characteristics, such as the building of crude stone (megalithic) monuments, the making of mummies, and the use of the symbol known as the "swastika" for good luck.

In the old Maya civilization of Yucatan, for example, have been found many of these customs and ideas, very similar to those of the Egyptians.

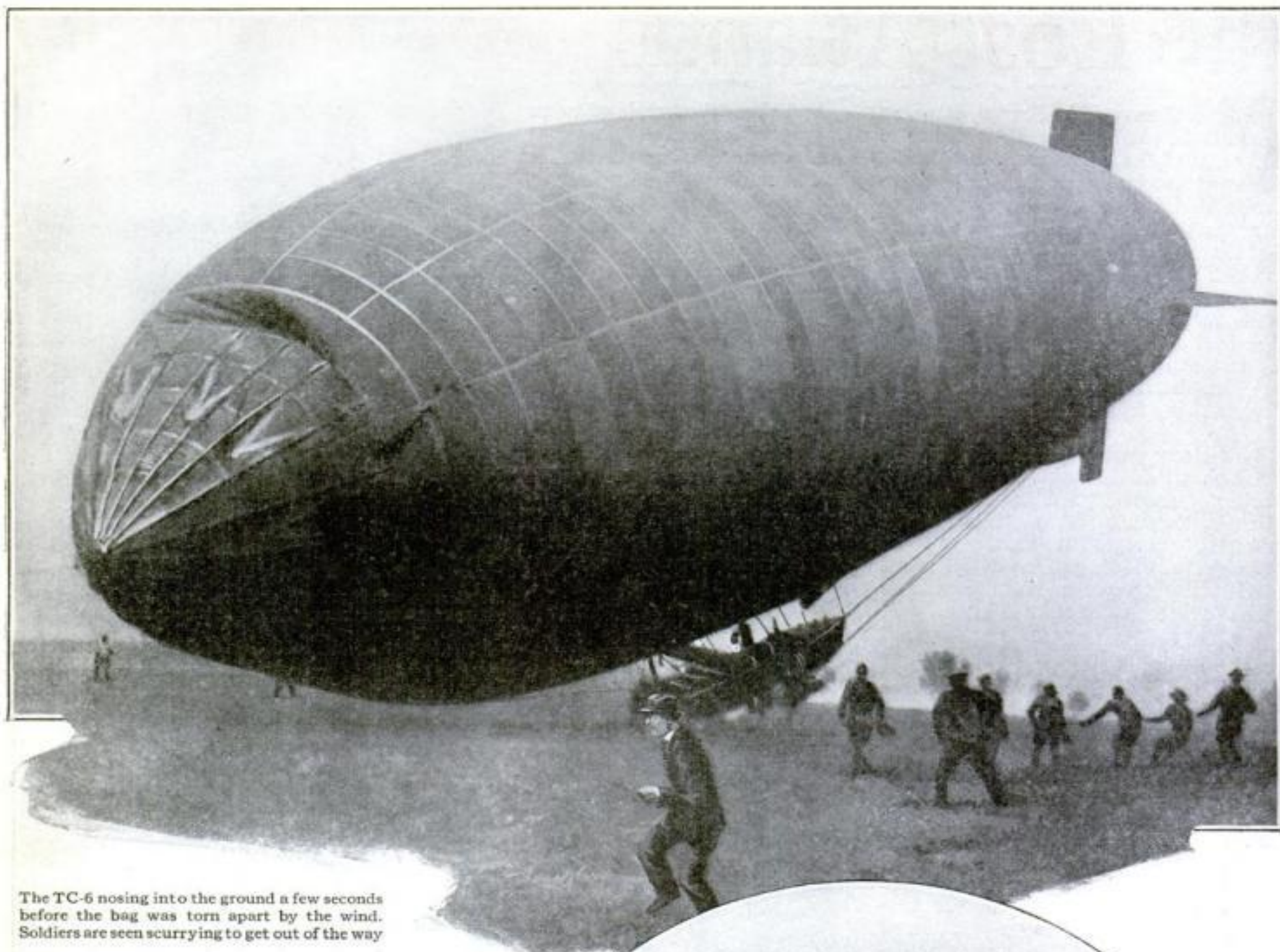
The custom of mummification runs through Central and South America. In Guatemala there is a river Nil (Nile) on the banks of which are pyramids. And only a few weeks ago, in the ruins of a buried city uncovered from the side of a hill near Arangaricuaro,

Mexico, there were found idols that are strikingly similar to idols of ancient Egypt.

Where did these people, so widely distributed, come from? What was their common origin?

In his attempt to establish that northern Africa was the cradle of civilized man, Count de Prorok early this year undertook the excavation of the sites believed to cover the ancient Phoenician cities of Utica and Carthage. In Utica, temples, villas, tombs, and countless relics of civilizations that once flourished in northern Africa already have been uncovered. In Carthage he claims to have unearthed an Egyptian culture that preceded the Phoenicians by at least 500 years, and to have found traces of at least half a dozen succeeding civilizations.

(Continued on page 111)



The TC-6 nosing into the ground a few seconds before the bag was torn apart by the wind. Soldiers are seen scurrying to get out of the way.

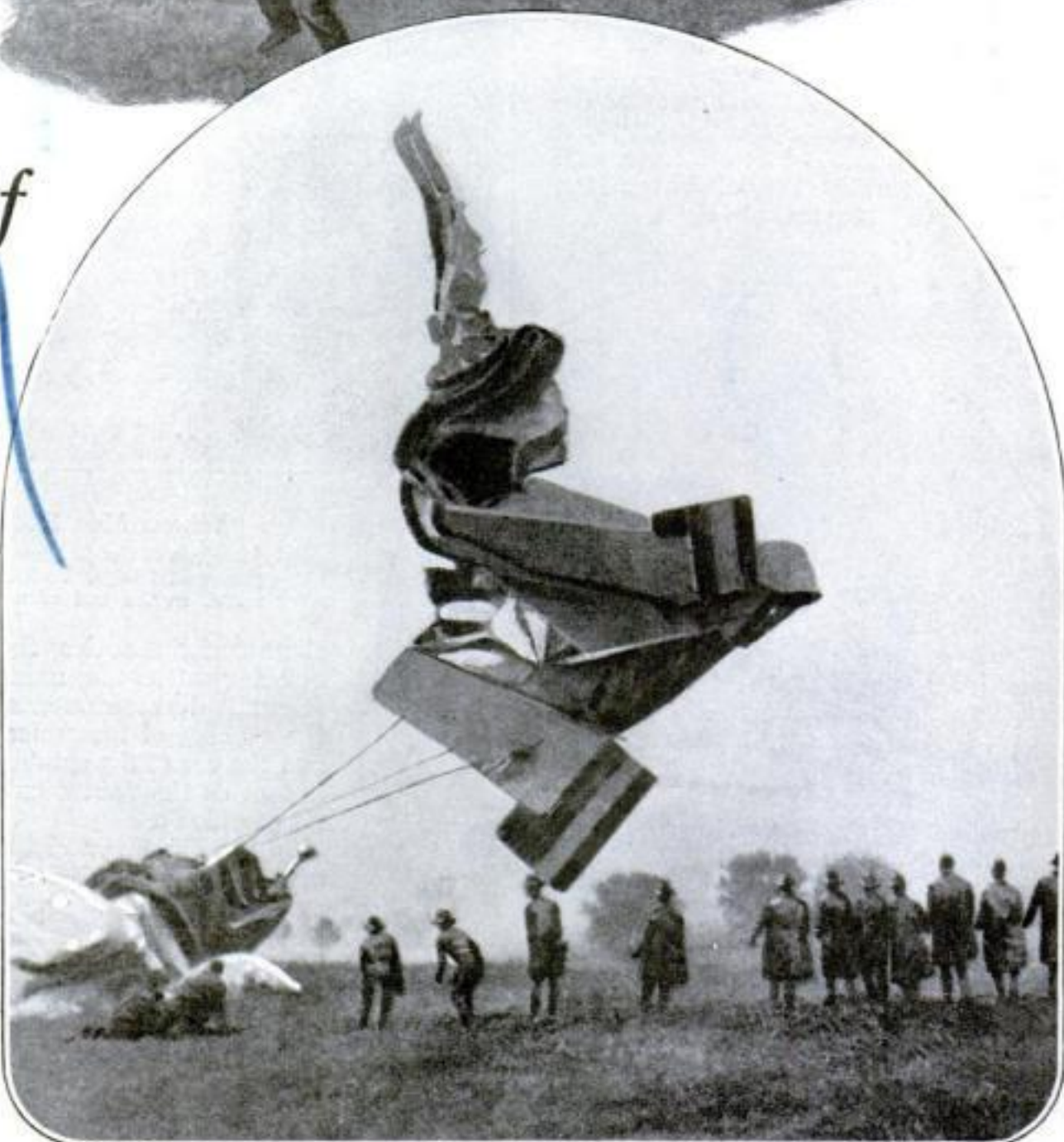
The Wreck of the TC-6

THESE remarkable exclusive photographs are probably the first ever made of the collapse of a dirigible in the air. They were snapped by an amateur photographer at Fort Crook, Omaha, Nebr., just as a high wind snatched the army dirigible TC-6, bumped its nose on the ground, and ripped the great bag in half.

Warned that a storm was brewing, 200 soldiers had been rushed to the ship to hold it down. The officers, believing they might ride out the storm, hurriedly climbed aboard. The motors were slow in starting. As the wind rose in fury, Capt. E. W. Hill saw it was futile to try to take off. He shouted to the crew to let go and get out of the way, and the officers jumped from the cabin.

At the same instant a terrific gust hit the bag and ripped a great hole in the rear. The ship crashed, nose first, and as the bag collapsed, the rudders, torn from the rear, were hurled 50 yards.

Among the spectators was Walter S. Johnson, an insurance agent, carrying a small pocket camera. Although little experienced in photography, he snapped four spectacular pictures of the collapse in two minutes.



The tail of the dirigible, torn off by the storm, photographed as it was falling to earth. It was carried 50 yards. At the left may be seen the rest of the blimp as it settled on the

ground, a shapeless mass. Luckily, no one was hurt. These remarkable photographs were snapped by one of the spectators who happened to have a pocket camera with him.

Perils Lurk in the Summer Sun

How Your Desire for "a Good Coat of Tan" May Cost You Serious Illness or Even Death — By C. F. Pabst, M.D.

ONE night last summer I was called to attend one of the worst cases of sunburn I ever have seen. The patient was a young man who had spent the day at a bathing-beach and, like many persons whose opportunities for outings are few, had made the most of his time, remaining in his bathing-suit for hours under the broiling midsummer sun.

Now he was paying for his indiscretion. His face was fire-red and swollen. His arms, shoulders and legs literally were scorched, just as if he had exposed his naked body to the heat of a blast furnace. His eyes were narrow

slits. He was nauseated and had a high fever. He screamed with pain when I attempted to treat him.

For three days he remained in bed, deathly ill and scarcely able to move. His was an extreme case, and yet it was typical of thousands of others that come within my own and other skin specialists' experience every summer. For few persons seem to realize that a severe case of sunburn actually is a dangerous affliction that causes not only excruciating pain, but may permanently affect the health, cause chronic skin diseases, and even result in death.

So little do people understand sunburn that they often martyrize themselves by deliberately burning their skins, not for the beneficial effects of sunlight, but to acquire a "coat of tan."

An office worker goes to the beach for a week-end. He decides to get a "good coat of tan" and impress his fellow workers on Monday morning. He gets the tan, but doesn't appear Monday morning. He is in bed. The statistics of hours lost from work on account of sunburn, if such records were available, I am sure would be amazing. In fact, a tanned skin is no index to health. A bronzed skin may cover the most serious of body disorders.

JULY and August are the dangerous months for sunburn, for then the sun delivers the most ultra-violet light, the invisible part of sunshine that burns the skin.

Ultra-violet light, we recently have discovered, helps cure many ills. It is especially beneficial in treating skin diseases such as acne and eczema. But while it is good for us to be in the sunshine, out of doors, the danger lies in getting too large a dose of ultra-violet light in a single exposure.

Sunburn is caused when ultra-violet light is stopped in the skin cells. The



He Is Courting Trouble

The office worker who goes to the beach for the week-end and sleeps on the sand in his bathing-suit is courting trouble. Monday is likely to find him in bed with a bad case of sunburn.

light causes a chemical change. A poison is manufactured that enters the blood, causing fever and headache. The chemical burn kills the skin. Some of this dead skin has to be absorbed by the blood, and this process adds to the poisoning.

All this means extra work for the blood. Large supplies of blood rush to the burned surfaces with consequent disturbance of

the circulatory system. This may be followed by congestion of the lungs and inflammation of the kidneys.

The heat of sunshine has nothing to do with the burning. You can prove this for yourself. Expose your arm to a 90-degree temperature before a fireplace or immerse it in hot water. The skin reddens, but the redness disappears when the heat is removed. Expose your arm in direct sunlight of the same temperature for two or three hours and you will receive a burn lasting for days.

Sometimes, not always, sun-



Freckles

The weather-beaten skin of Earl Sande, famous American jockey, who rode Flying Ebony to victory in the last Kentucky Derby, is typical of the kind that freckles, instead of tans. In other words, the pigmentation or discoloration of his skin, instead of being distributed evenly, collects in small spots

burn is followed by pigmentation—discoloration of the skin—the familiar "coat of tan." Sometimes this pigment, instead of being distributed evenly, collects in spots that we call freckles. The pigment is manufactured in the deepest layer of skin cells. Under a microscope the pigment looks like tiny particles of brown paint. The more of these particles manufactured, the darker the skin becomes.

But perhaps you are one of those unfortunate individuals who never tan. You suffer far worse from sunburn than your bronzed companion. Why?

The latest experiments with ultra-violet light lead us to believe that the

(Continued on page 113)

How to Avoid Sunburn

1. Protect yourself from direct rays of the sun in July and August.
2. Build up a coat of tan, if you can. This deposit of pigment will prevent the sun from burning your skin.
3. Acquire this tan gradually through short exposures.
4. If you have a skin that doesn't tan, stop exposing yourself. For you, every new exposure means a new burn.
5. Wear a hat with a brim or carry a parasol.
6. Don't go to sleep on the beach in direct sunlight.
7. Don't go fishing or boating in the middle of the day in sunshine. Reflected light from the water will burn you, even though you wear a hat.
8. Remember that a severe case of sunburn may have serious and lasting results.

The Wonder City You

Buildings Half-Mile High and 4-Deck Streets



The Architect and His Vision

Harvey W. Corbett, noted American architect, at work on one of his models depicting his conception of the future city

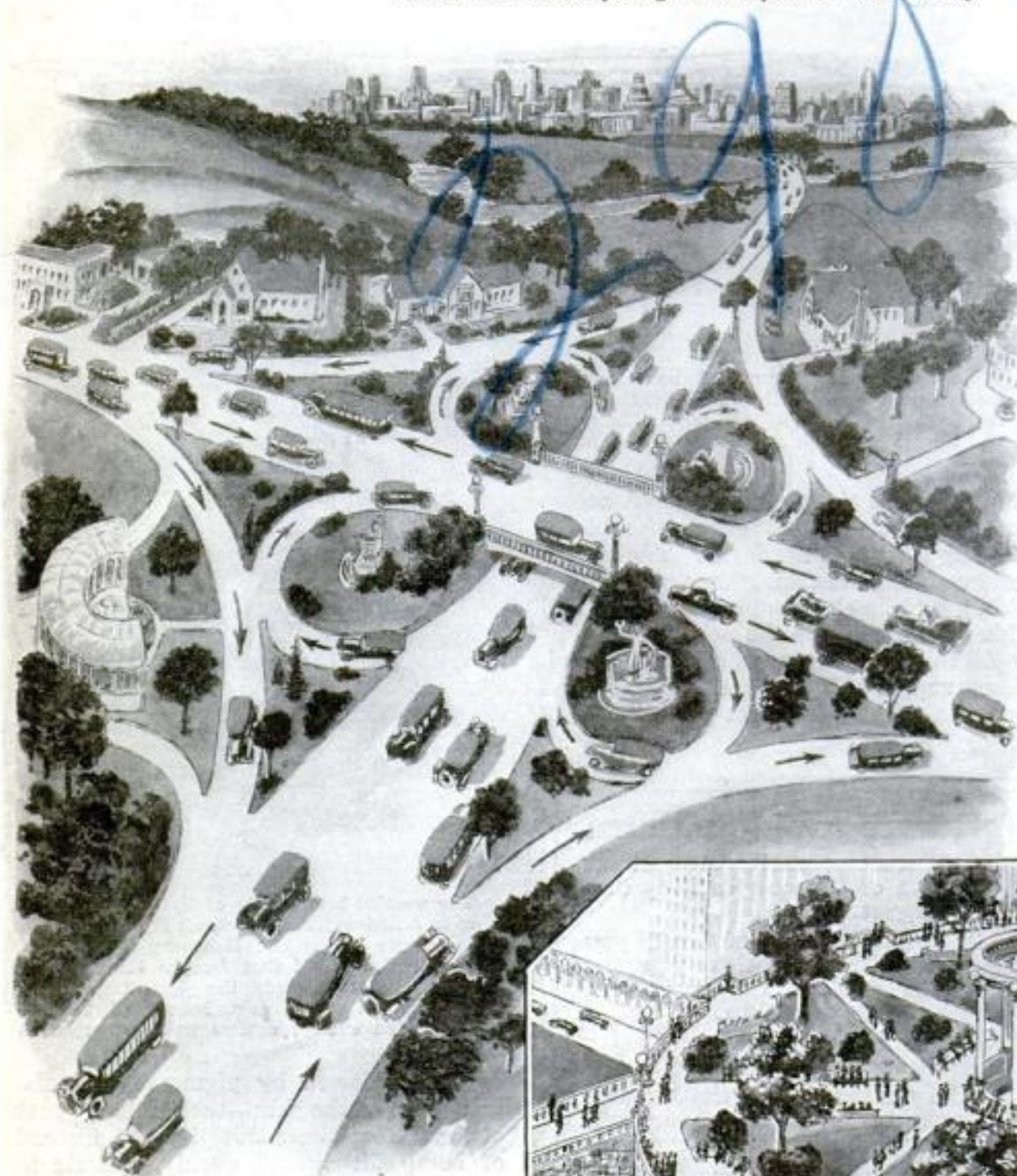
THE amazing pictures on these two pages were drawn from suggestions made by Harvey W. Corbett, president of the Architectural League of New York. They are a vivid, graphic expression of Mr. Corbett's mental conception of the typical American city of the future—the place in which most of us will be living in a quarter of a century or so.

Unlike many other experts, Mr. Corbett does not believe that the future will bring the "decentralization" of our big cities. On the contrary, long study of modern trends in architecture, city planning, and business and social life has convinced him that our cities will become more and more crowded. And, facing this contingency, he believes, we of this generation should begin now to plan buildings and highways with an eye on the problem of handling people and traffic of the future.

THE streetcar and elevated railway, Mr. Corbett says, will disappear. Streets will consist of four or more levels, respectively for pedestrians, slow motor traffic, fast motor traffic, and electric trains, the uppermost level being raised above the present street level.

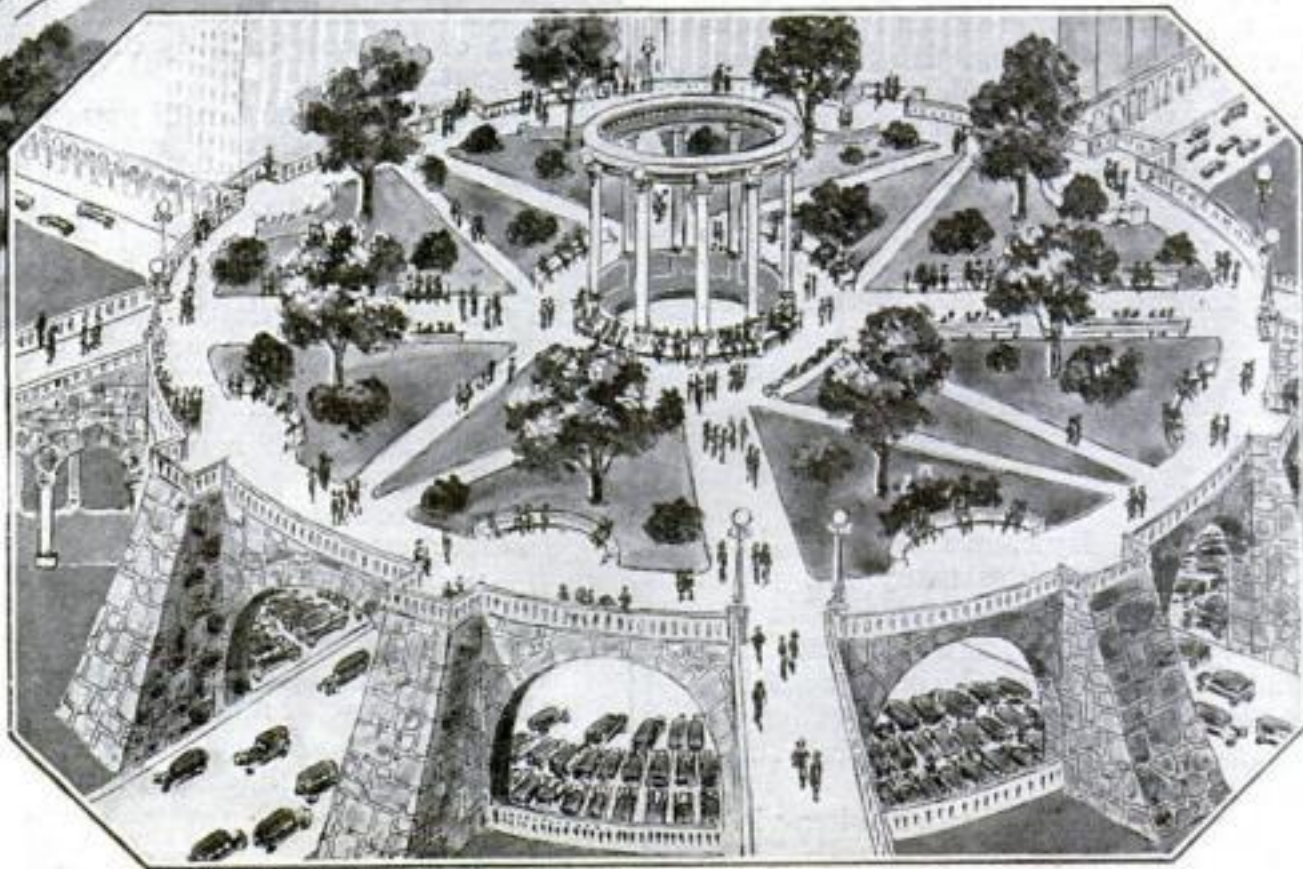
Buildings will be half a mile high or more, containing offices and commercial establishments on the lower floors, and dwellings and amusement places on the upper. These latter will be reached by spiral escalators and will be supplied with pure air piped from the country.

Though Mr. Corbett's vision of the future city contains much imagination, it is in no sense fantastic. It is supplied by a practical man and a noted architect. His ideas are worthy of sober study. A picture of the present-day metropolis, with its skyscrapers and subways, would have seemed scarcely more remarkable 50 years ago than his conception of the future city seems today.



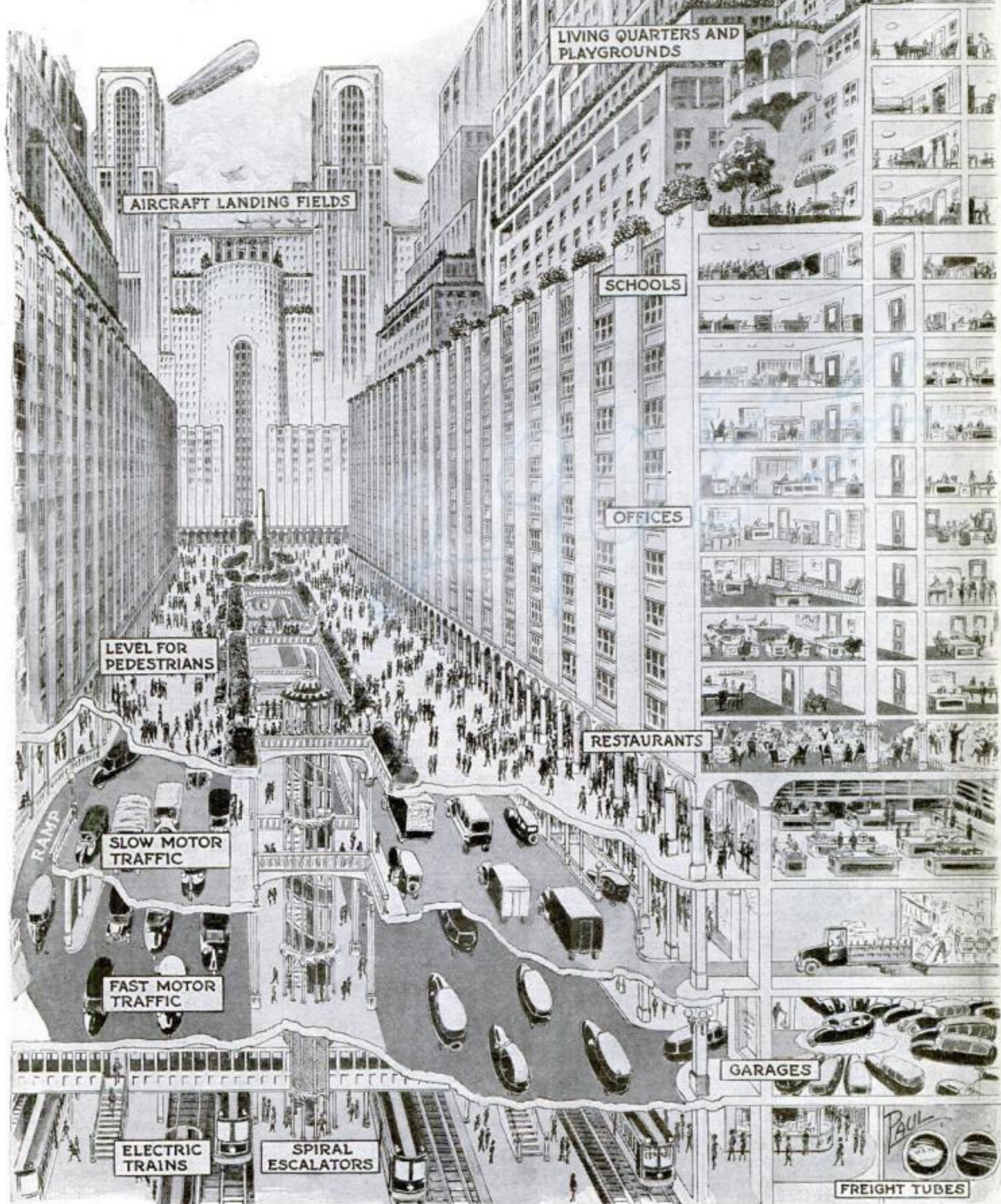
Safe Highways—Elevated Parks

Above is a conception of how highways from the city of the future will be arranged to prevent congestion. Notice how the cross highway is elevated, with an ingenious system of curved ramps leading from one highway to the other. If you follow the arrows you will see how a car traveling in either direction on either road could pass readily to the intersecting highway without danger of accident. Mr. Corbett foresees future city parks raised to the level of elevated streets, as shown at right, with convenient auto parking space beneath



May Live to See

May Solve Congestion Problems



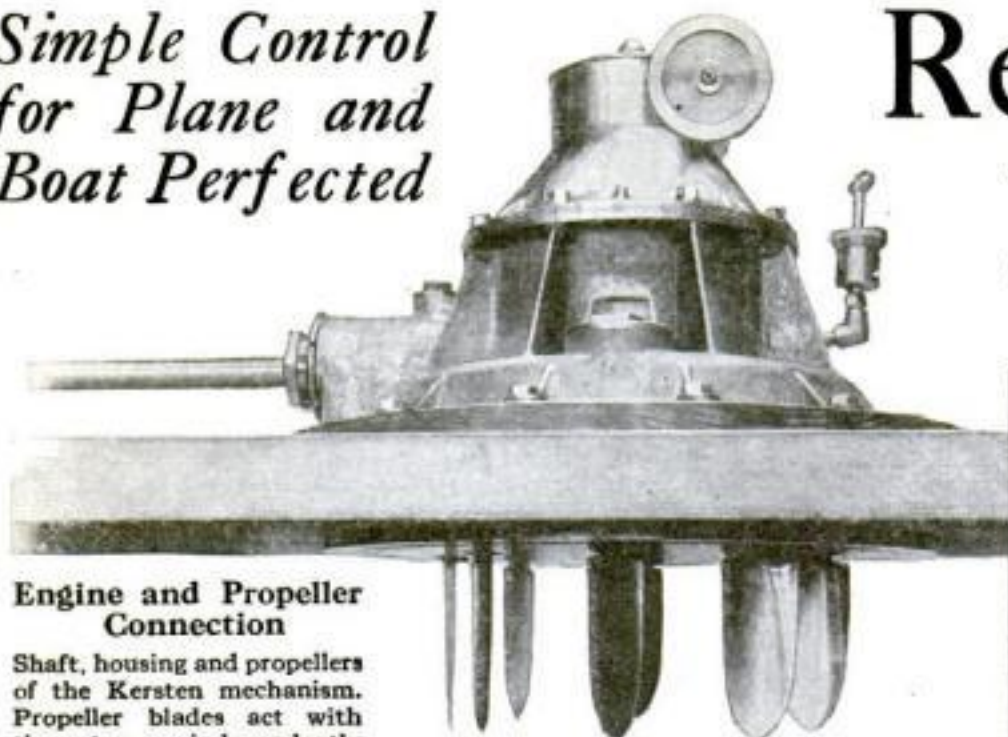
How You May Live and Travel in the City of 1950

Future city streets, says Mr. Corbett, will be in four levels: The top level for pedestrians; the next lower level for slow motor traffic; the next for fast motor traffic, and the lowest for electric trains. Great

blocks of terraced skyscrapers half a mile high will house offices, schools, homes, and playgrounds in successive levels, while the roofs will be aircraft landing-fields, according to the architect's plan

Simple Control for Plane and Boat Perfected

Revolutionary New Propellers



Engine and Propeller Connection

Shaft, housing and propellers of the Kersten mechanism. Propeller blades act with the rotor or independently



Boat Turns in Its Own Length

The makers assert that a boat equipped with the propellers gives instant response to the wheel

By Arthur A. Stuart

TRULY revolutionary in principle is a new propeller for motor-boats and aircraft recently designed by Prof. F. K. Kersten of the Department of Electrical Engineering at the University of Washington, Seattle, Wash.

The amazingly simple mechanism serves at once as propeller, rudder, and reverse gear. It is in the form of a rotor or disk, set in the bottom of a boat. A number of blades project from this disk into the water. They are driven by spiral bevel gears from the engine.

The thrust upon the water is produced in two motions by these blades. First the axes of the blades are caused to move in a circular path with a uniform motion, the plane of the path being at right angles to the blades' axes. Second, while moving in the circular path, the blades are made to rotate on their own axes, this motion also being uniform. These two motions are so timed that each revolution made by all the blades around the circular path also makes one-half a revolution of each blade on its own axis. The consequent thrust given by the combined movement is controlled at will by a simple device incorporated in the propeller.

THE propeller blades revolve not only on the rotor's motion, but also independently of it. It is claimed that any boat equipped with the new propeller can navigate safely without reverse gear or rudder. The boat can be turned almost in her own length, so quickly will she respond to the action of the new installation. Again, it is said that even when going at full speed, a boat can be stopped in two lengths.

All movements are governed by the way the propeller blades are manipulated. In turning, a boat

How Propeller Is Installed

Illustrating the position of propeller on latest model streamlined motorboat. It is claimed by the inventor that need for rudder and reversing gear is eliminated by use of this invention

banks inward; danger of capsizing is therefore eliminated. The makers claim that boat construction is considerably simplified and that, due to the center-board installation, which stabilizes the boat, the finest streamlines may be adopted.

So impressed was the U. S. Government by the new propeller, that after repeated tests at Washington, D. C., it has ordered an installation of the aerial type to be made in the dirigible *Shenandoah*, and the marine type placed in the "admiral's barge" of battleships.

All the advantages claimed for the marine type of propeller, and even more, are claimed for Professor Kersten's aerial model.

Yet another new propeller, but of

entirely different construction, is the invention of a Frenchman, Jean B. Icre. The Icre propeller consists of a vertical housing through the bottom of the hull, with a simple mechanism that operates six propeller blades around a horizontal circle, requiring only a one-way power plant to drive it. This means that all engine-reversing mechanism is eliminated.

THE actuating mechanism is simply a cam at the end of the blade arm, following a circular guide within the housing. This guide causes a quarter-turn only of the blades from the horizontal to the vertical and return.

Because of its construction, maneuvering, such as is required of destroyer fleets, is said to be possible to a phenomenal degree.

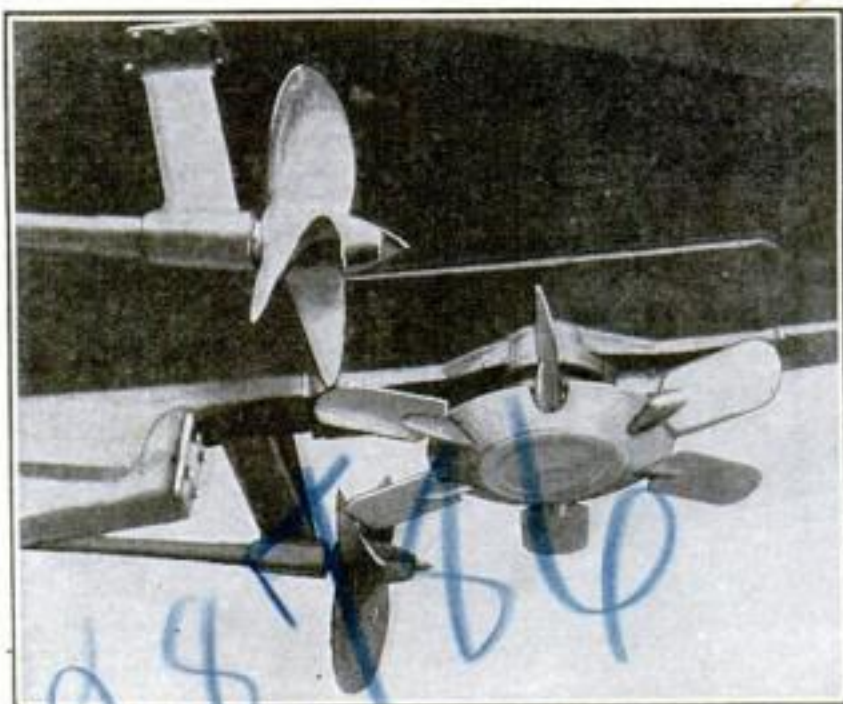
It is claimed that in tests conducted in a 40-foot vessel with engine running a corresponding number of revolutions, the Icre propeller covered a given course in from six to 12 per cent less time than that required for a screw propeller.

The basic principles of M. Icre's propeller have many applications—as for outboard motors, certain phases of dirigible control, and for deep-draft vessels, shallow-draft vessels, and particularly for towing craft.

Tailless Biplane Tested

FOLLOWING recent trial flights near Santa Monica, Calif., a tailless biplane weighing less than 500 pounds was declared practical by Prof. A. A. Merrill of the California Institute of Technology.

Such a machine in miniature, shot from a catapult, sailed more than 100 feet and maintained a speed of 35 miles an hour. It was held perfectly balanced in the air by currents from four large motors.



No Rudder nor Reversing Gear Needed

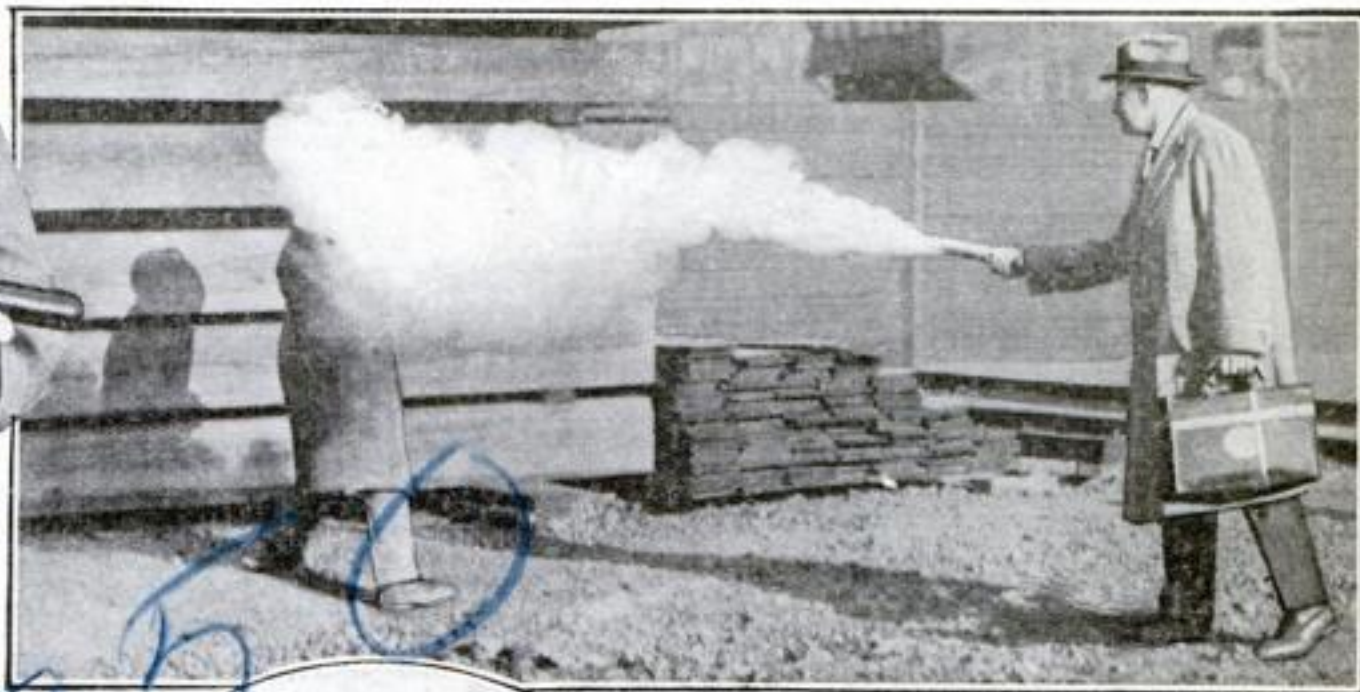
The Icre propeller has a vertical housing through the bottom of the boat's hull. A simple mechanism operates six propeller blades on a horizontal circle. Reversing gear is eliminated

Where nightsticks are useless and shooting uncalled for, policemen now are using the billy, shown below. It will project a stream of blinding mustard-camphor liquid 30 feet



Tear-Gas Bombs Rout Mob

Army Trains Police in Use of War Gases



MODERN warfare methods are being adapted for use by police departments in several large cities in the United States. Tear-gas bombs, grenades, maces, and billys are used for attack and defense. A gas mace or billy, it is claimed, will enable a single officer to accomplish more than 20 men equipped with the old type of night-stick.

The mace shoots out a volume of gas, enough to fill an ordinary room. The grenades are said to be particularly effective for breaking up mobs and riots and driving barricaded criminals from retreats. Huge crowds can be set to weeping instantly, so that not one of their number can see, and no mob will continue once blinded with irritating tears.

Smarting of the eyes and tears continue for from two to five minutes after exposure to the gas. The exposure is harmless, since the gas has no permanent injurious effect.

The mace has the same size, shape, and weight as a standard police night-stick. When pointed at a man or group of men and a button pushed, a cloud of tear gas



is projected from the end for a distance of from 20 to 30 feet. The charge is much like a shotgun shell and can be installed easily. The billy is like the mace, except that the barrel is shorter.

One hand grenade, it is claimed, will

Using Gas for Self-Defense

Above: Officers demonstrating how a bank messenger can shoot gas at would-be hold-up man, rendering him helpless and unable to resist arrest. Center: Soldiers instructing San Francisco policemen how to shoot tear bombs from a rifle. Some of the police students shown in the illustration are carrying gas masks, which they must learn how to use

stop a mob of hundreds in an 80-foot street. Thrown into a large hall, a tear grenade will cause every occupant to retire hastily. The grenades do not explode, are weather-proof, and are provided with a safety device so that they can be stored indefinitely.

Rifle grenades are built on the same lines as hand grenades, but these can be fired from a rifle with blank cartridges. These weapons are used when greater range is desired by the men who are using them.

At army posts soldiers are acting as instructors to policemen, showing them how to handle the new tear-gas equipment.

Ten-Year-Old Boy Is Hero of African Hunting Expedition

ONE day last winter an interesting party sailed from New York for Nairobi, British East Africa. It consisted of Mr. and Mrs. E. L. King, of Winona, Minn., and their 10-year-old son, Ernest. Accompanying them was an official photographer, a motion-picture cameraman, and an expert taxidermist from New York's Museum of Natural History. Mr. King also had been commissioned by the University of Minnesota to get specimens of big game.

Escorted by a safari of 75 natives, the party entered the jungles of Africa. Though it was their first experience with the big game of the dark continent, they were by no means amateurs, having hunted in South America, Canada, Alaska, Florida, and China.

Mr. King is a well known marksman, and Mrs. King was at one time world's champion clay-target shot, and twice champion of the Northwest, while their son has handled a rifle since he was six.

After about four months in the wilds, the Kings returned home, with Ernest, Junior, the hero of the expedition. Unaided, he had shot and killed a huge rhinoceros with his 30-30 rifle. Mrs. King killed several lions, and 400 cases of specimens were sent to Minnesota and to New York's Museum of Natural History.

Intrepid Young Sportsman

Ernest King, Jr., 10-year-old big-game hunter, beside the rhinoceros that he killed single-handed in the wilds of British East Africa, where he spent a holiday with his parents



HAVE You Met the Crafty Doodlebug, or the Ants that Keep Cows?



Courtesy
Educational
Film Ex-
change, Inc.



Nature's Craftiest Hunter

A ferocious doodlebug or ant-lion is seen above devouring an ant it has captured in its powerful jaws. At the left the same ugly insect is preparing to dig the pit for his victims

There Are A Thousand Different Insects in Your Back Yard

Amazing Stories from a Near-By World of Bugs and Flies

By G. B. Seybold

ONE afternoon, not long ago, Dr. Frank E. Lutz was showing a friend the back yard of his suburban home in Ramsey, N. J. The two men were examining a peculiar-looking insect on a rosebush. In the course of a conversation about insects Doctor Lutz remarked, "Every year there are at least 500 species of insects in my back yard."

The friend expressed surprise and skepticism, and Doctor Lutz determined to prove it. Today in the American Museum of Natural History in New York City, where Doctor Lutz is Curator of the Department of Entomology, there is a collection of 836 species of insects that were caught in that one New Jersey back yard. And the collection is incomplete. When all of the specimens are mounted and labeled, Doctor Lutz expects the exhibits to amount to well over a thousand. One thousand different species taken from a plot 75 by 200 feet!

All of us who have a back yard are probably boarding as many varieties of guests—perhaps more, for the garden in this case is in no way unusual. It is in the middle of a village of about 2000 population. Part of it is planted in vegetables, part in flowers, and part is lawn.

The surprising collection moreover, was made casually, during two summers. The insects were caught while Doctor Lutz was strolling in his garden, or when the electric porch light attracted swarms of them, on summer evenings.

In all but one of 23 general classifications into which all insects are divided, representatives were found, either in the

house or yard, and Doctor Lutz says that you can find fully as many in your own garden, if you will look for them.

Sorting your principal insect visitors



Here is the friendly lady-beetle dining on destructive plant lice or aphids. These lice have now become the servile "cows" of ants

into groups easily remembered, you have (1) true flies—those that have no more than two wings—such as mosquitoes; (2) butterflies and moths (scaly-winged insects); (3) beetles; (4) wasps, bees, and ants; (5) true bugs, such as the squash bug, which have sucking mouth parts, and (6) grasshoppers.

BUT what about spiders? With that question you disclose a slight acquaintance with insects, for a spider is no more an insect than a crab is. For one reason it has too many legs—two too many, to be exact. Only six-legged creatures come under the classification of insects, and a spider has four pairs.

The insects in your back yard help themselves to the foliage of your fruit trees, bushes, vegetables, grass roots, and plant stems. Every plant in the garden furnishes refreshment for at least one species of insect. Some insects, such as the roach, prefer cooked foods. What-

ever man likes is good enough for him, so he sticks close to kitchens, where he manages to steal a bit now and then. Roaches have tagged man about the world for thousands of years, even following him on ships when he crossed the seas.

The most numerous of your back-yard guests are aphids, or plant lice. If left to grow unmolested, the hordes of these would bring starvation to all of us, by destroying all vegetation. Next in number in the garden are ants, and a distressing fact is that these two classes have joined forces.

The lice are the ants' "cows." They excrete a sweetish sub-



Corner of Doctor Lutz's back yard at Ramsey, N. J., where he found at least a thousand different species of insects

stance called "honey-dew," which is very much liked by certain species of ants. These ants work hard to care for their tiny "cows."

ONE species of ant, the *Lasius niger*, exercises particular protection over the corn-root aphid. During the winter this ant stores the small black eggs of the lice in its nest, moving them around as the weather changes, to keep them dry. When the eggs begin to hatch in early spring, the ants uncover the roots of smartweed and other plants and put the cows out to pasture. Then, when the farmer has at length put in his corn crop, the ants make a last transfer and transport the lice to the corn roots.

Fortunately for us, lice have enemies as well as friends in the insect world. One of these is the lady-beetle. All of us know the little rhyme warning the lady-bird to fly away home to save her children from destruction from fire. Doctor Lutz explains that the rhyme originated in Europe, where hop vines are burned after the harvest. These vines are usually full of the young of lady-beetles dining on plant lice. The name "lady-beetle" dates from the Middle Ages when these insects were dedicated to the Virgin and called the "Beetles of Our Lady."

Horticulturists in California, realizing the good these beetles do, often scoop up big masses of the adults from the piles in which they congregate for the winter, and put tons of them in cold storage. They distribute them in the season when plant lice should be controlled.

Another enemy of plant lice often seen flying about electric porch lights in evenings, is the aphid-lion. This is a rather large but delicately formed crea-



Opens World's First Insect Zoo

THE most amazing zoo in the world—a 40-acre menagerie of insect life—has just been opened to the public in the Interstate Park near Tuxedo, N. Y. It is the idea of Dr. Frank E. Lutz, Curator of Entomology of the American Museum of Natural History, who is shown in the photograph.

Doctor Lutz's fascinating observations of the thousand insects in his own back yard are described in the accompanying article. Now, under his direction, the American Museum is giving the public a chance to view and study these wonders. Visitors at the zoo will learn of Nature's useful jobs for her bugs, beetles, bees, and flies.

Doctor Lutz has estimated that this remarkable zoo will contain at least 5000 kinds of insects.

the best ways to control insect pests, entomologists advise, is to stir up warfare. Increase the number of the pest's enemies and let them fight it out, cheering from the side lines.

Craftiest of all garden insects is the ferocious-looking doodlebug or ant-lion which develops into the marsh fly, resembling the slender-bodied dragon-fly but with more delicate wings. Bright lights have a fatal attraction for it, so you may make its acquaintance some night when you have forgotten to mend the hole in your window-screen.

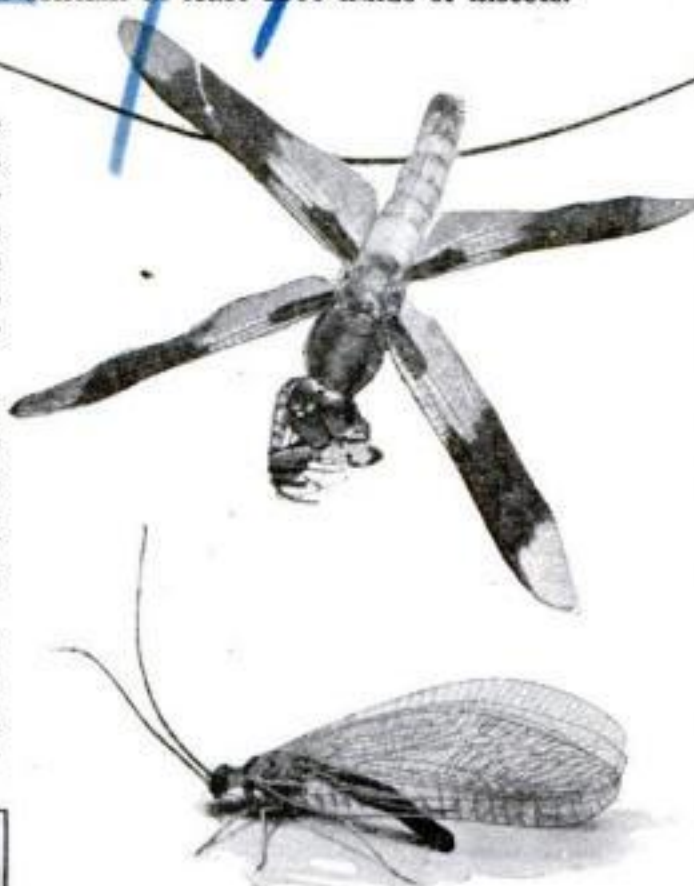
The doodlebug larva makes a pit in loose gravel the shape of an inverted cone and hides at the bottom with just its powerful jaws protruding, ready to seize its prey. An ant or other insect tumbles into the trap, assisted in its fall by showers of sand thrown up by the lion. Once in the pit, the victim's fate is sealed.

Few insects are injurious in all stages of their life. In fact, as a rule, it is only the grub or caterpillar that does the damage.

Some insects are often easy to see and destroy in one stage or another. The eggs of the tent caterpillar, for example, are deposited in bands, 300 or 400 to a band, encircling a small twig of some tree, preferably an apple or wild cherry. These bands are rounded at the ends and covered with a protective "varnish." In the winter, when there are no leaves to hide them from view, they can be detected easily and destroyed.

TENT caterpillars have an interesting colony life. When the eggs hatch, all the caterpillars join in spinning a temporary silken tent around what is left of the egg mass. From here they go out

(Continued on page 115)



Two Interesting Creatures

The upper picture shows a dragon-fly, or darning-needle, eating an insect while in flight. This vicious-looking but harmless fly swoops down and scoops up its prey in its basket-like legs. Below is the aphid-lion, a voracious enemy of plant lice. Doctor Lutz tried to count how many lice one of these could devour in one meal, and gave it up

ture with light green, lacy wings. Its young are so voracious that if it laid all of its eggs in a mass, the first one hatched would eat all of the rest. So the mother spins stalks of stiff silk and sticks one egg on the end of each stalk. Thus all are given an equal chance.

Doctor Lutz, curious to know just how many plant lice one aphid-lion could consume at a single meal, tried to keep count one Sunday afternoon. He got tired counting, he says, and turned the insect loose on the honeysuckle vine to keep on with the good work. Doctor Lutz goes out into the fields, gathers aphid-lions and turns them loose in his garden. One of



The Camping-Ground of Pests

A colony of tent caterpillars in the forks of a tree. When these pests are gathered in their tent it is possible to destroy them easily

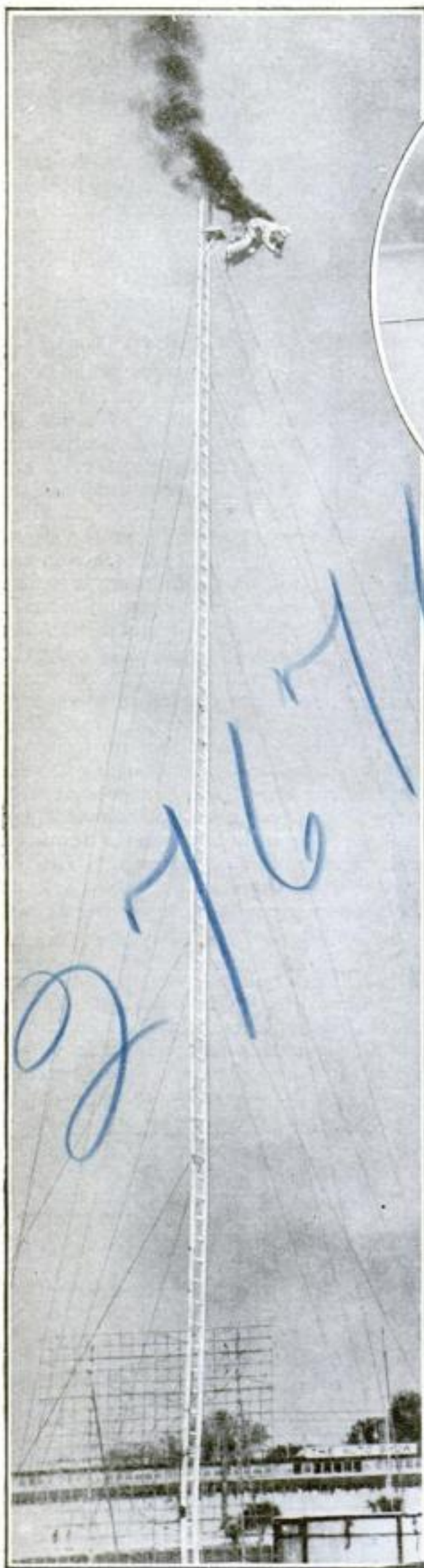


A Battle in the Flowers

One of many thrilling battles of the insect world. This remarkable photograph shows a hornet swooping down to attack a bee

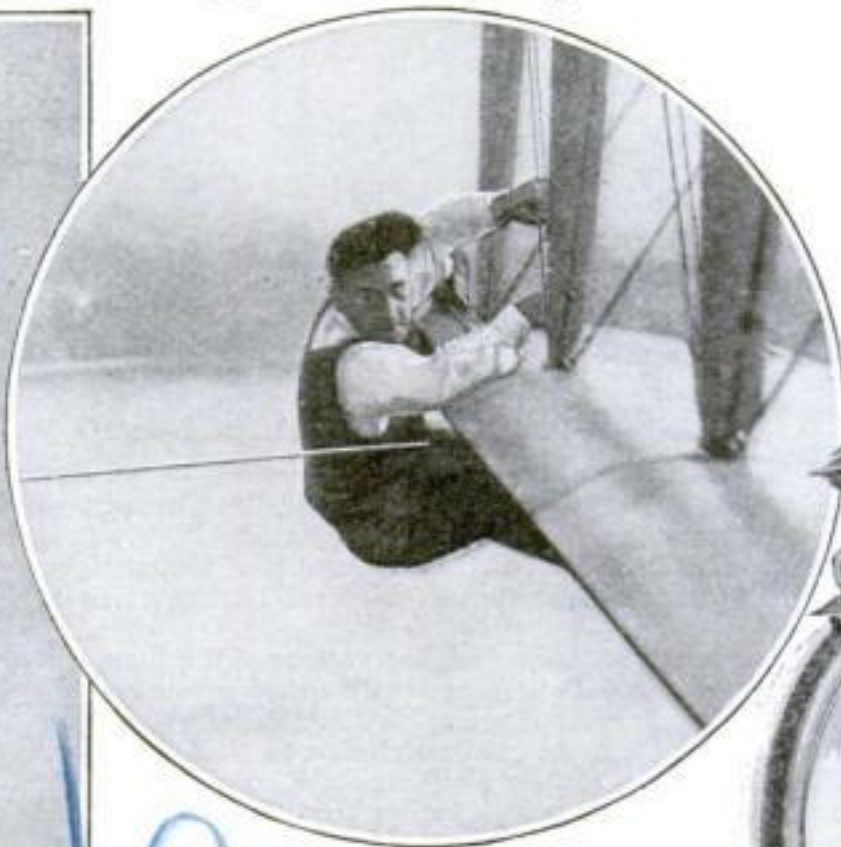
Would *You* Like Their Job?

These Daredevils Defy Death for a Living



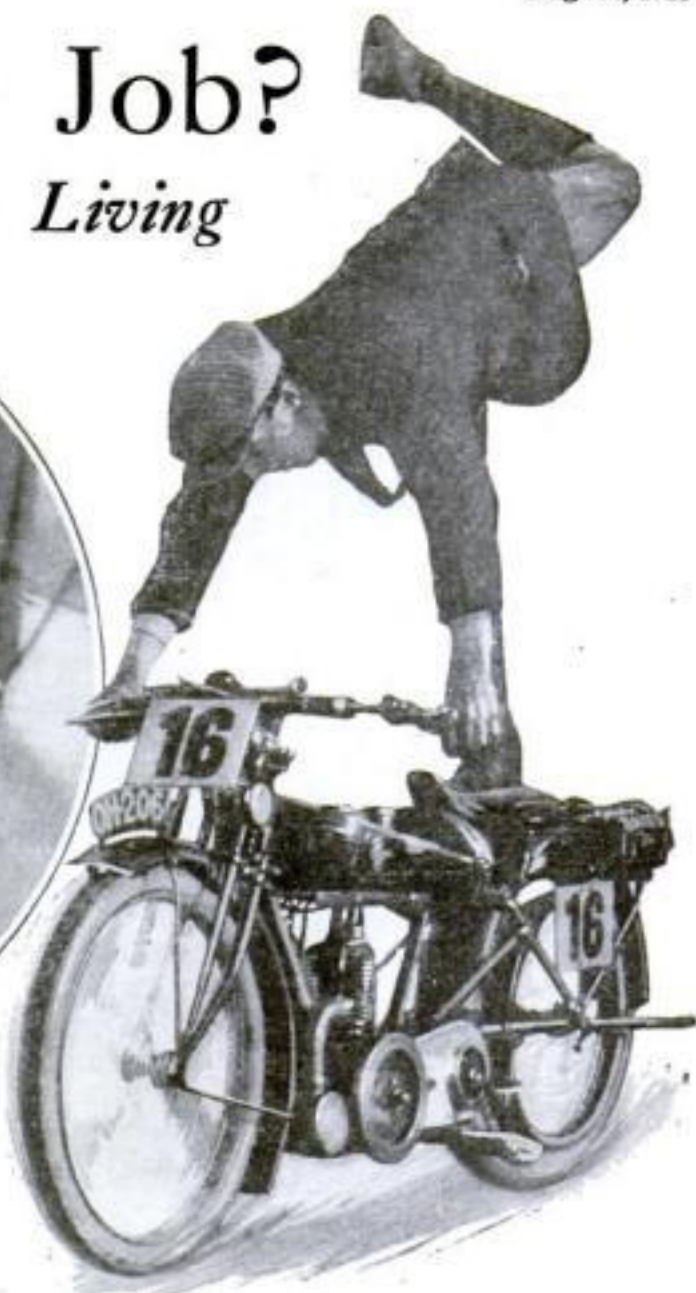
Florida's Human Torch

Providing thousands of spectators with thrills and chills, Daredevil Wilson daily climbs this ladder, saturates himself with gasoline, sets fire to his clothing, and plunges from the dizzy height of 125 feet into the water-tank below



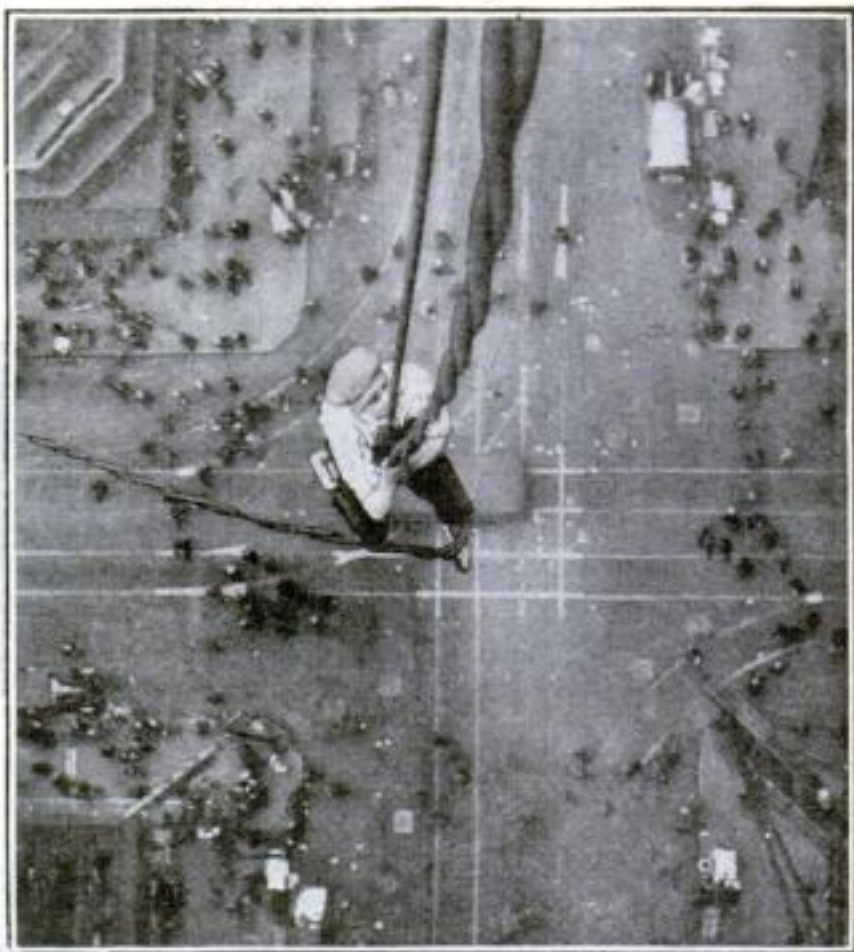
If He Should Let Go

Charles N. Fitzgerald is a past master at performing hair-raising stunts on the outskirts of an airplane, thousands of feet above the earth. He climbs from the fuselage, steps lightly out on a wing, and dangles in midair, supported only by a wire strut



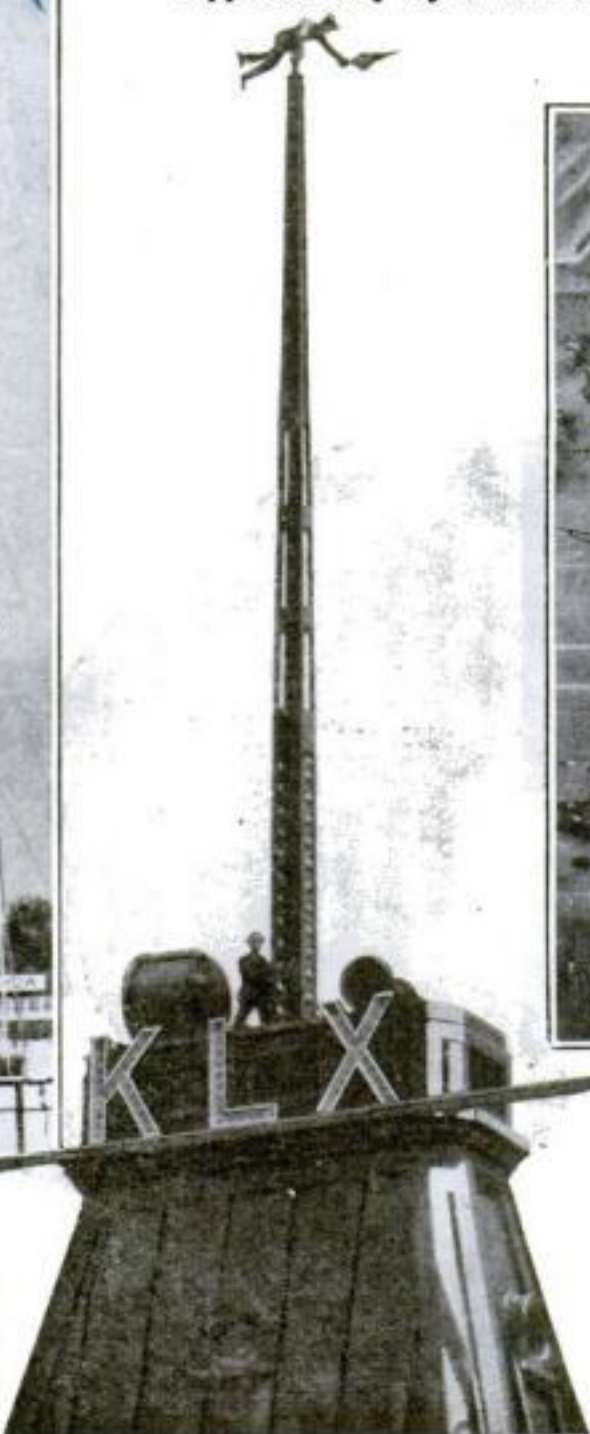
Try This on Your Motorcycle

Motorcycle rodeos furnish a constant supply of hairbreadth escapes from injury or death. Albert Milner, champion trick motorcyclist, is pictured above, doing a very difficult stunt



Suspended between Earth and Sky

Above: Benny Fox calls himself the "human fly" and he is shown performing on a rope high above Chicago's streets. At left: Carl Anthony, of Oakland Calif., has climbed to the top of the flagpole of the Oakland *Tribune*, some 300 feet above the sidewalk, and is doing hazardous stunts on the apex of the slender shaft, nonchalantly supporting himself on one hand, and meantime keeping his balance with an umbrella, closed, at that

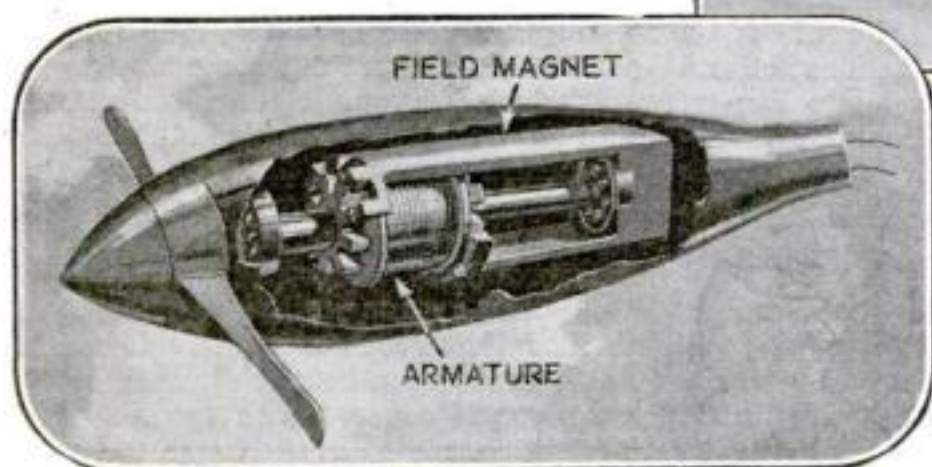
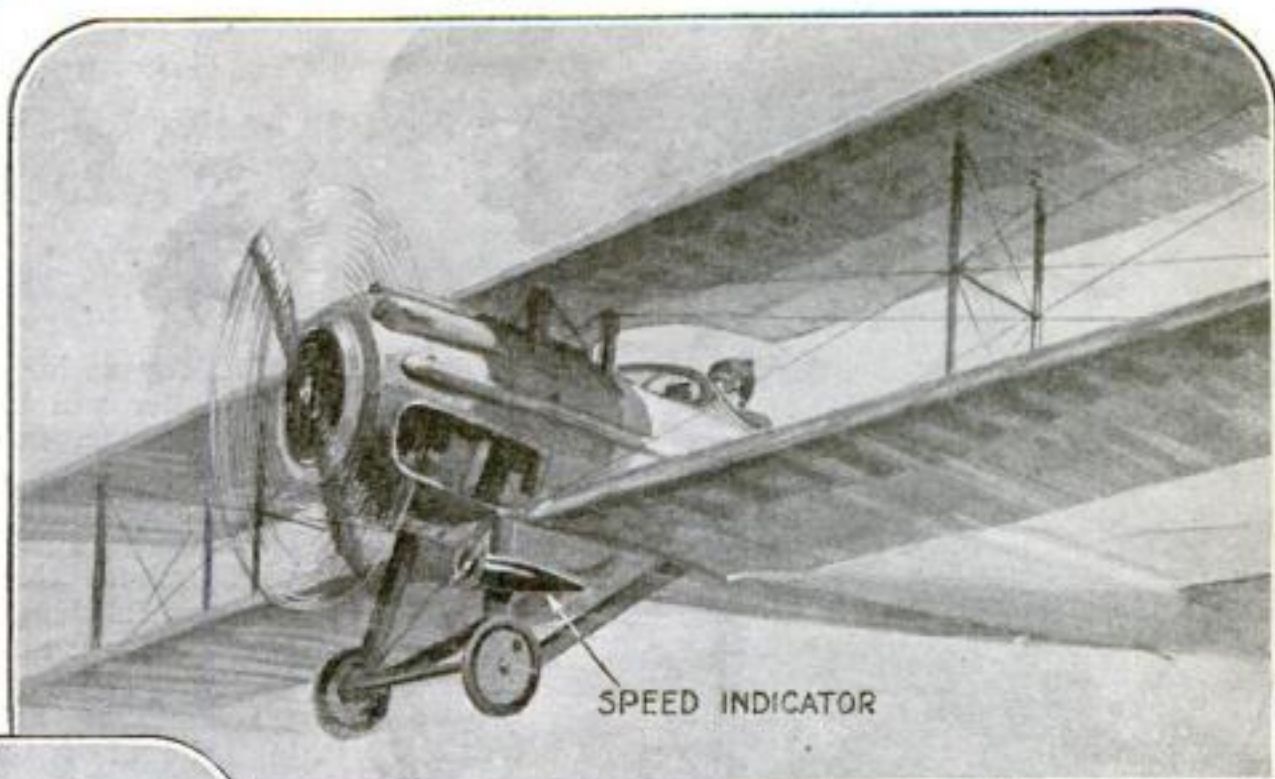


Pilot Controls His Speed by Sound

THE perfection of a remarkable acoustic speed indicator for airplanes, which makes it possible for a pilot actually to hear the speed of his machine in flight, recently was announced by M. de Gramont de Guiche, before the French Academy of Science.

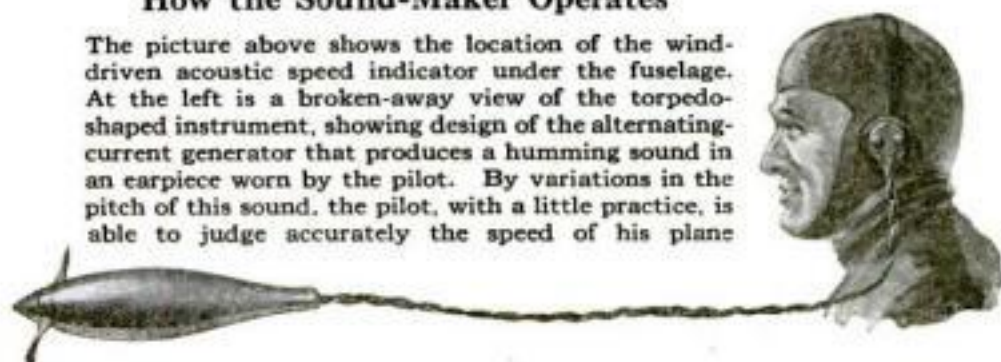
The invention is a small torpedo-shaped instrument, with a two-bladed propeller at its nose, attached under the fuselage. Air pressure set up by the plane's forward motion drives the propeller, which, in turn, drives a small alternating-current generator. The speed of rotation, of course, depends on the speed of the airplane.

The propeller shaft is placed between the arms of a fixed U magnet, which end in ring-shaped pole plates. Between



How the Sound-Maker Operates

The picture above shows the location of the wind-driven acoustic speed indicator under the fuselage. At the left is a broken-away view of the torpedo-shaped instrument, showing design of the alternating-current generator that produces a humming sound in an earpiece worn by the pilot. By variations in the pitch of this sound, the pilot, with a little practice, is able to judge accurately the speed of his plane



these plates the wire-wound spool of the generator is mounted around the shaft, without touching it. Between the end plates of the fixed spool and the armature rings of the magnet poles, circular disks are keyed to the shaft. Each disk has

eight teeth, corresponding with the same number of teeth in the armature rings.

As the propeller shaft revolves, an alternating current is generated. This reaches its maximum every time the teeth of the disks are alined with the teeth of

the armature rings. Thus each full revolution produces eight maximum impulses that are transmitted to an earpiece worn by the pilot, creating a humming sound, which varies in pitch with the speed of the plane.

A "Second Wind" for Airplanes Six Miles Up

FROM New York to Paris in a few hours is one of the possibilities held forth by Louis Damblanc, as a result of his invention enabling airplanes to fly swiftly at high altitudes.

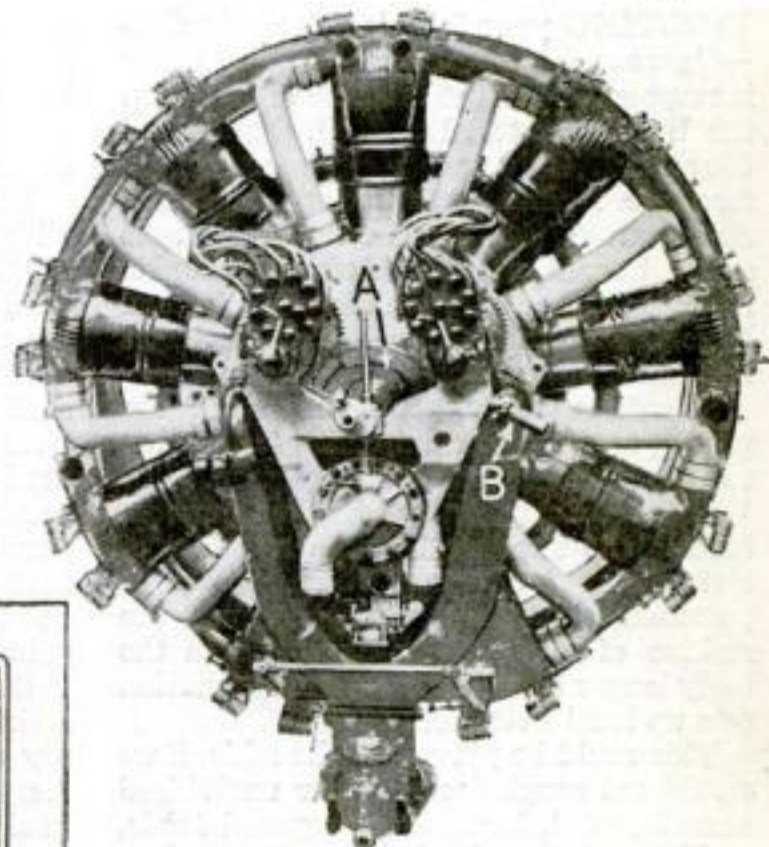
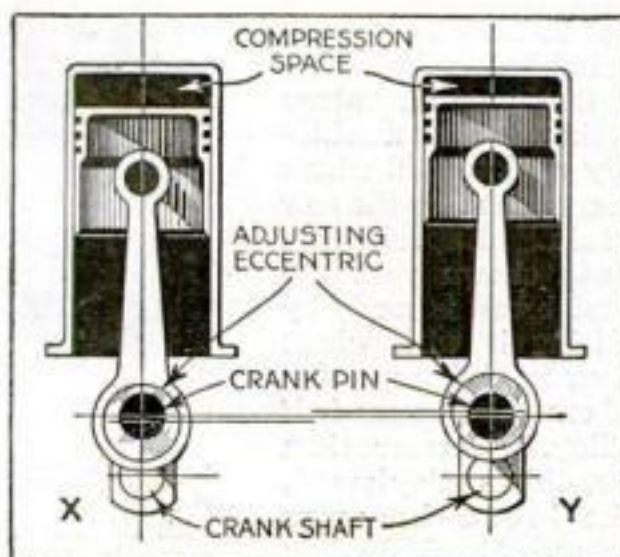
By a simple apparatus built into the engine, this French engineer claims to have mastered the upper atmosphere in a way never before approached.

Under present conditions an engine loses half its power at an altitude of 3½ miles. With the Damblanc attachment it is declared the loss will be reduced to little or nothing, even at a height of six miles. The French Air Service has supervised successful tests of the apparatus, the importance of which is indicated by the fact that it was laid before the French Academy of Sciences by President Paul-Frudent Painlevé, of France.

In upper altitudes the speed possibilities are vastly greater because of lessened atmospheric resistance. With existing equipment, however, the loss of engine power has made it impossible for aviators to take advantage of this.

To overcome this difficulty by increasing compression in the cylinders, Damblanc has modified engine construction to enable the pilot, at will, to change the length of the connecting rods that move the pistons in the cylinders, and so vary the space in the compression chambers.

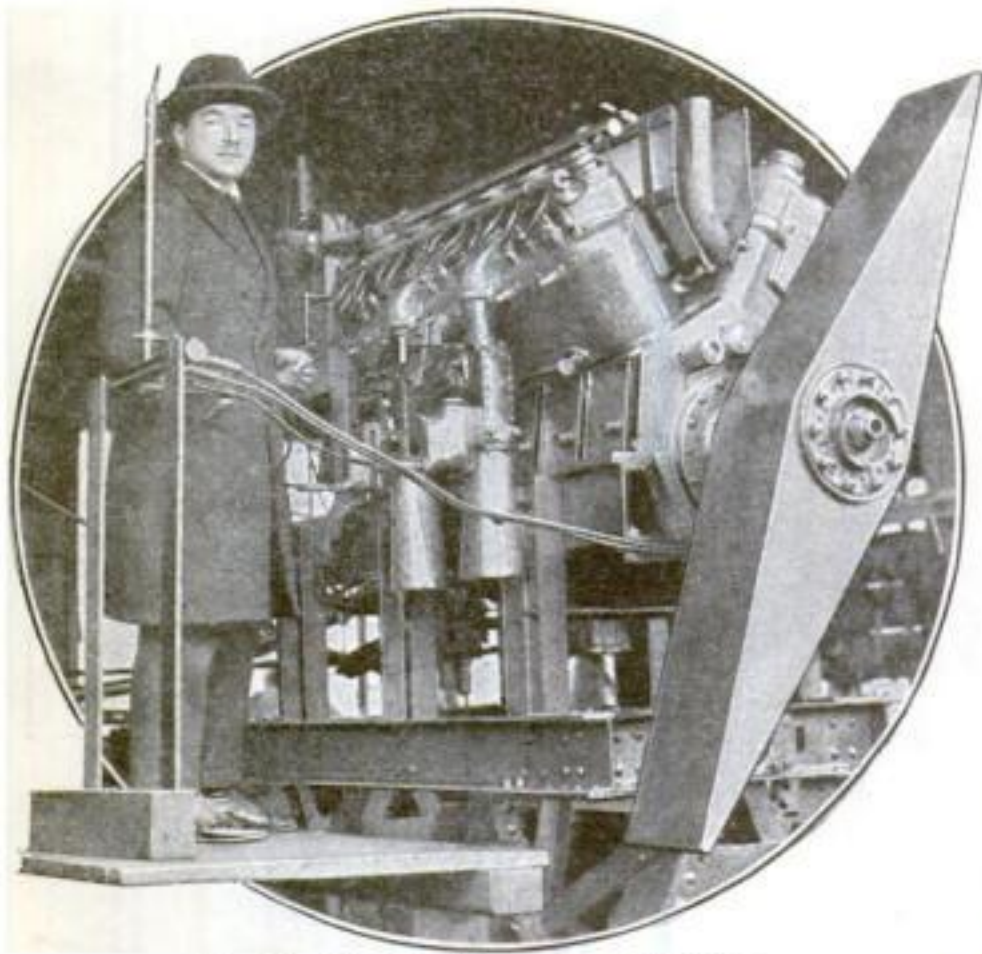
The secret of the device lies in an eccentric crank-pin arrangement. When the eccentric is set at the point (shown at Y in the theoretical diagram) the compression space is reduced and the motor will function at high altitudes. When the eccentric is in the other position of minimum elongation (shown in X) the piston does not go as far into the cylinder. This enlarges compression space, and so lowers compression to the proper point for running at ground level.



The Power Booster

Above is an airplane motor equipped with the new power-increasing device. Arrow A points to the housing of the device; arrow B points to the adjusting lever. The diagram shows the eccentric crank-pin arrangement by which compression space in the engine cylinders is reduced at higher altitudes. X shows position for running at ground level, and Y for high altitudes, changed at will by the pilot

Dangers in Bolting Your Food



New Engine for Transatlantic Flight

Rene Fonck, French ace of aces during the war, is shown here with the new airplane engine he has designed especially for transatlantic flight. This motor has run on the block at full speed for 120 hours continuously.

DO YOU know the practical, dollars-and-cents value of keeping well informed? Are you moving ahead with the world's advance, or are you letting yourself slip backward? It is to help you keep pace with the progress of events that POPULAR SCIENCE MONTHLY presents here, in brief, understandable form, the month's outstanding achievements in invention and scientific discovery.

BOLTING your food is extremely dangerous, for this common habit largely is responsible for the increase of cancer in the United States, Dr. J. D. Osmond, of Cleveland, Ohio, explained recently before the Radiological Society of North America. When a man under nervous strain, he said, swallows his food in chunks, it tends to be retained in the gullet instead of going on to the stomach. This irritates the gullet and frequently causes cancer.

Scientists throughout the world are paying an increased amount of attention to the rapidly spreading plague. Sir William A. Lane, a noted English surgeon, blames the unnatural habits and diet of civilization for cancer. The body is poisoned slowly, he says, because the residue of digested food remains in the body longer than it should and stagnation sets up local irritation.

This could be prevented, he adds, if we would eat rough foods as our uncivilized ancestors did, instead of prepared foods, highly cooked, milled and refined. The cause of every case of cancer he has ever had the chance to verify, he asserts, has been chronic constipation.

New York City is to be the first municipality in the world to erect a cancer institute of its own. Sufferers from cancer will have free treatment by the latest radiographic apparatus and a 200,000-

death. You have heard it said, perhaps, that the corn and wheat areas of the earth now are cultivated to the limit, and that some day the increasing population will not have enough bread.

Be cheered by the news that P. J. Wester, a scientist of the Philippine Board of Agriculture, has discovered remarkable possibilities in adlay, a grain grown in the tropics. He says it will take the place of either wheat or corn, if need be.

We are acquainted with one of its near relatives—Job's tears, hard seeds used often for ornamental beads. The adlay has a softer shell than these. Natives in the tropics have used the seeds for generations for ornamental purposes, but not for food, because they could not be hulled easily by primitive methods.

One great advantage is that the same machinery used to mill wheat can be used for the new grain. Experiments have shown that the best bread is made by mixing it with wheat flour in the proportion of one-third to one-half adlay. When more than two-thirds adlay is used, the bread becomes heavy. Cracked adlay

volt X-ray machine. The latter will be housed in an isolated one-story building, having thick walls lined with lead, so that the powerful charge of electricity can be used with safety.

It is amazing that in spite of these tremendous efforts to conquer cancer, it should still remain one of the most dreaded diseases known to man.

A New Grain

DON'T worry about the world starving to

makes a very acceptable breakfast food.

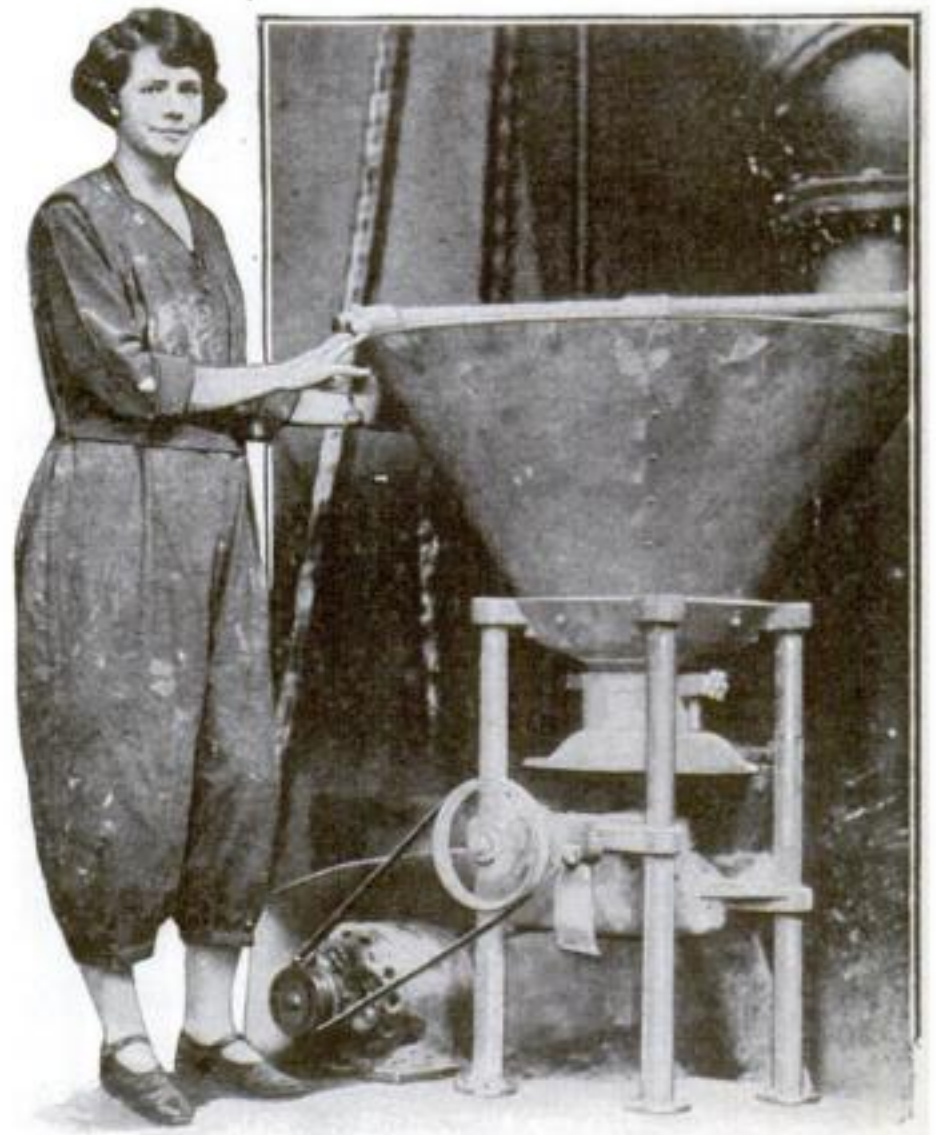
The plant is a kind of coarse grass growing seven or eight feet high, with long leaves similar to those of corn. The grain is inclosed in a soft shell. It has an amazing yield—an average of 2550 pounds to the acre.

Spider Webs as Fish Nets

IF YOU lived in a tropical country you might become lazy, too, and use your wits only to figure out some way to get work done for you. Natives of Australia and the South Sea Islands induce spiders to furnish them with fish nets.

The webs are spun by large spiders with bodies about two inches long, and are extraordinarily tough and durable. Natives bend a strong twig into a hoop, take it into the woods and wave it among spider webs spun between branches until the hoop is covered with meshes. Fish become entangled in the tough web when it is immersed in a stream, and are caught easily.

Natives of New Guinea bend a piece of bamboo into the shape of a big tennis racket. They place this upon a bush and



At Work to Purify Our Rivers

Miss Louise E. McGrath, C.E., who holds the distinction of being the only woman chemical engineer in the United States, is at work with Uncle Sam to prevent the pollution of streams. Here she is, operating an apparatus that purifies water used in factories.

spiders obligingly weave a strong web upon it. Fish up to a pound in weight can be caught in such a net.

Daring Adventures

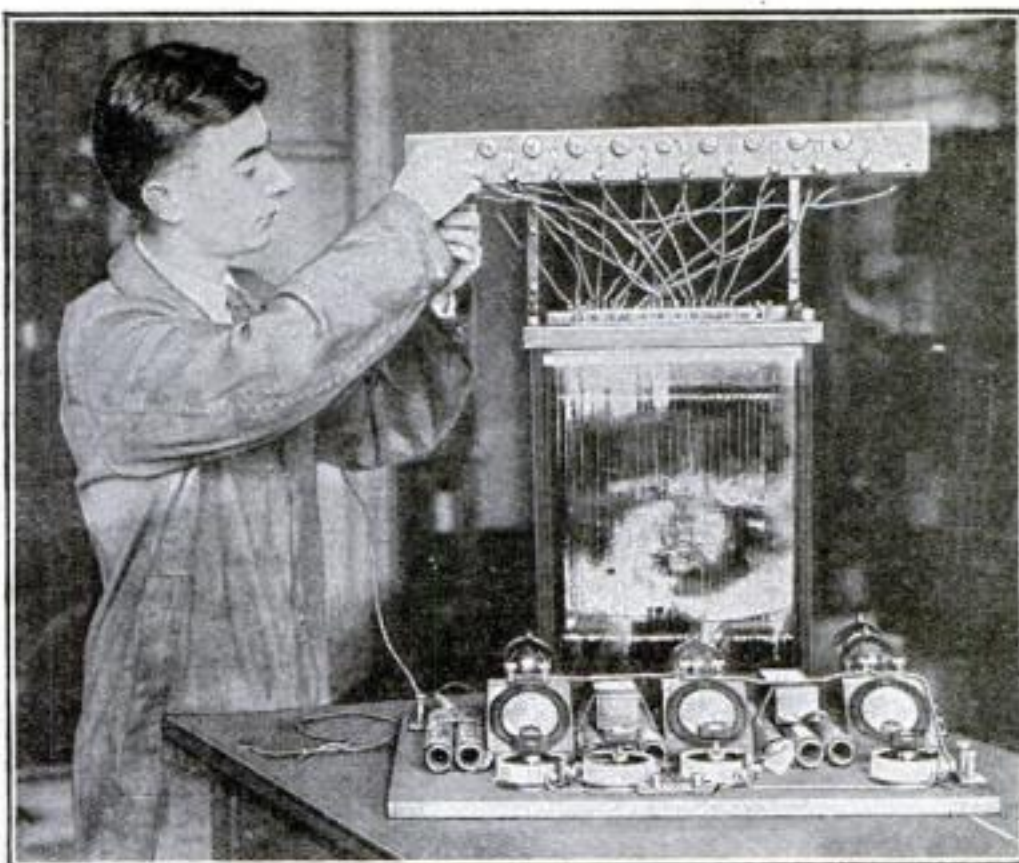
THE world is full of adventure for the man who seeks it. Into the midst of tribes of savage Amazonian head-hunters who greet visitors with poisoned arrows, an expedition led by Dr. William McGovern is penetrating this summer. The explorers will study the mysterious customs to be found in South American country between the Andes and the Amazon valley.

Little is known about the savages here, except that they keep pigmy slaves and shrink the heads of victims, by a secret process, to the size of an apple. The explorers expect to impress the natives with jazz records and radio.

Doctor McGovern was the daring adventurer who, disguised as a servant, got into Lhasa, the forbidden city of Tibet, about two years ago.

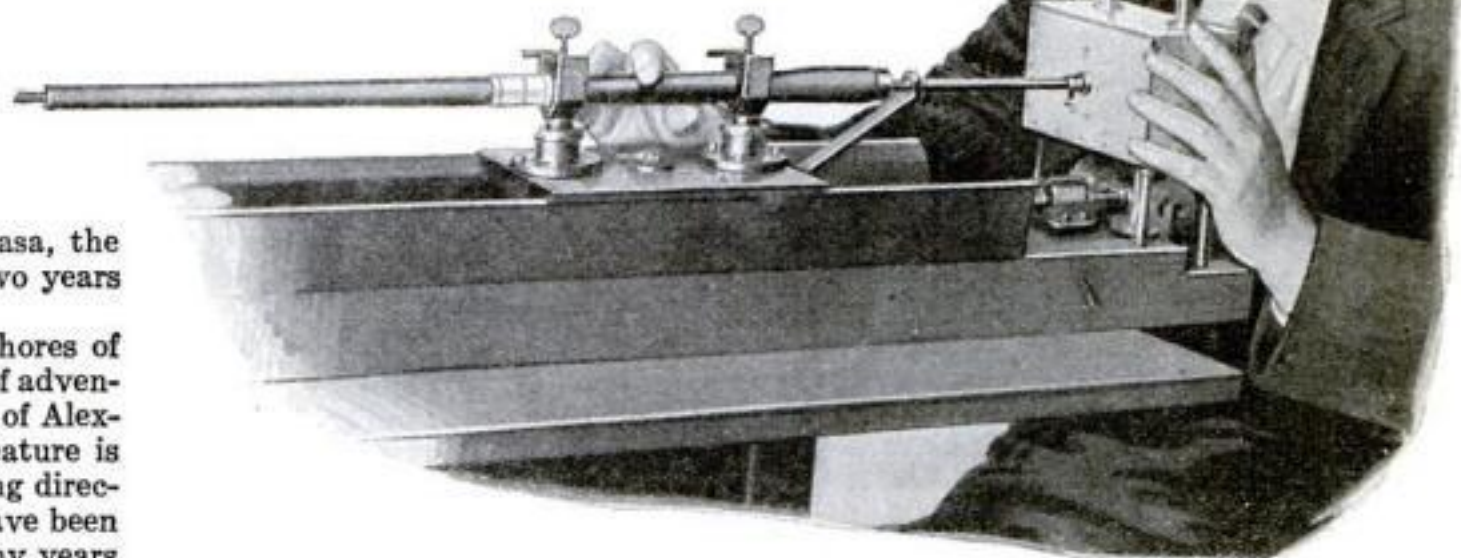
In Baku, Azerbaijan, on the shores of the Caspian Sea, another party of adventurers is digging for the treasure of Alexander the Great. A romantic feature is that the archeologists are following directions in an ancient map said to have been stolen from a Turkish sultan many years ago. Legend declares that this map shows the exact spot where the riches are buried.

At home, one of the most ambitious feats of American mountaineering is being



Cables Tested in a "Chemical Ocean"

Crowding 3000 miles into 24 inches for the study of transoceanic cable transmission has been accomplished through a remarkable "chemical-ocean" of a few quarts recently perfected in the electrical research laboratories of the Massachusetts Institute of Technology. The apparatus, consisting of a glass container in which aluminum plates are suspended in solution, makes it possible to duplicate actual transmission conditions existing in cables on the bed of the ocean.



He Photographs Interior of Rifle Barrel

By means of a remarkable periscopic camera invented by Dr. I. O. Gardner and F. A. Case, it now is possible to photograph the interior of either a rifle or a cannon barrel.

undertaken by 11 men, all amateur climbers, who are attempting the ascent of Mount Logan, the highest mountain in Canada. It is 19,850 feet high, second only to Mount McKinley in North America, and has never been scaled.

It is approached from Alaska over a perilous route mapped out by Captain Albert H. MacCarthy of New Jersey. The expedition is under the auspices of the Alpine Club of Canada, but it includes five climbers from the United States. The summit of the peak is 11,000 feet above the highest available base site, and there is great danger from avalanches.

Achievements in Flying

THREE planes designed to fly 300 miles an hour are being built for the United States Army and Navy for entrance in the Pulitzer Trophy Race this fall. With these it is expected that the United States will recover the world's speed record from France, which now holds it at 278 miles.

A new world record for non-stop flights was made recently by the PN-9, an all-metal naval

plane, which flew 28 hours and 36 minutes without stopping. It came down only because its supply of gasoline was exhausted. It carried 1450 gallons.

The test was made to see whether the plane could hop from California to Honolulu successfully. From the speed maintained in the trial it was estimated that the plane would have flown just far enough to have covered this distance.

Our Mentality Exposed

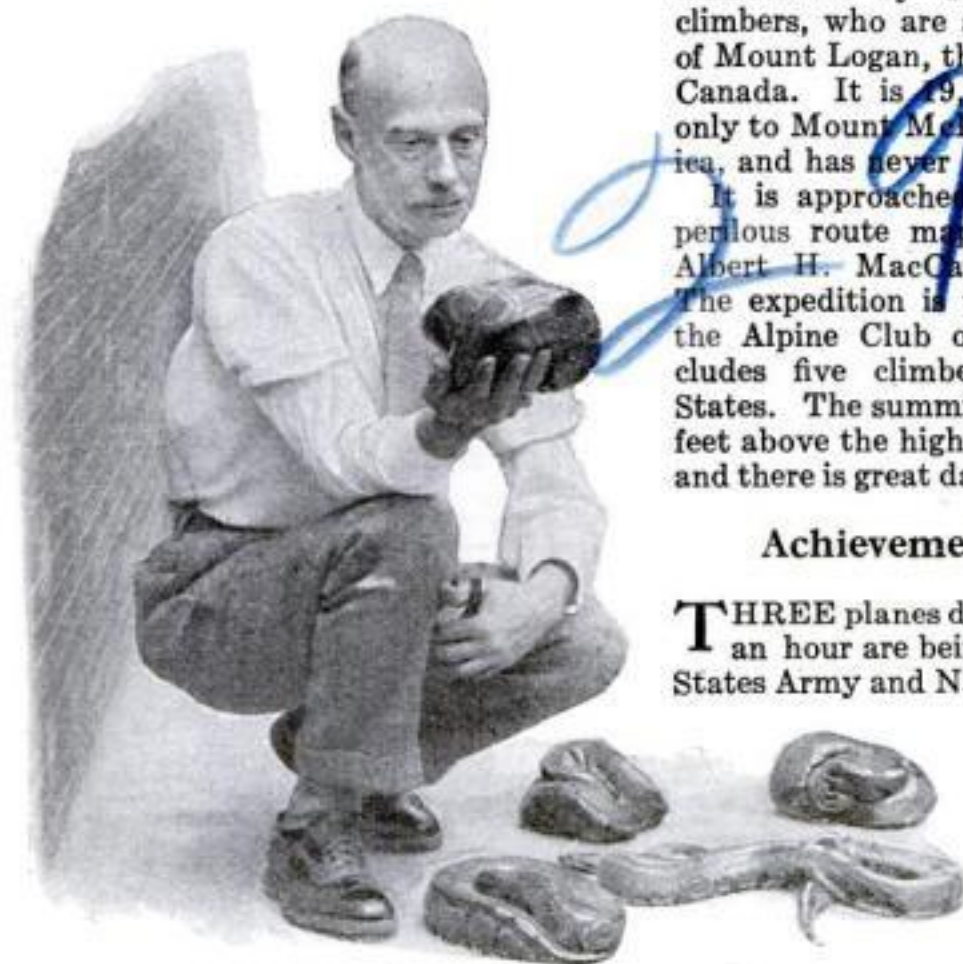
MUST we admit that we are stupid? A group of University of California scientists, after many years of study, have decided that the human race has made no mental progress in 3000 years. They have concluded that we know about as much today as the people who lived in Babylon, and not as much as the Greeks did 2000 years ago.

Doctor Robert Millikan discovered that by merely substituting familiar names of persons and places for unfamiliar ones in writings of the ancients, these writings could not be distinguished from the modern.

And people are still shamefully superstitious, it was found. One test showed that of 977 California teachers 875 believed seriously in black cats and dropping spoons as omens.

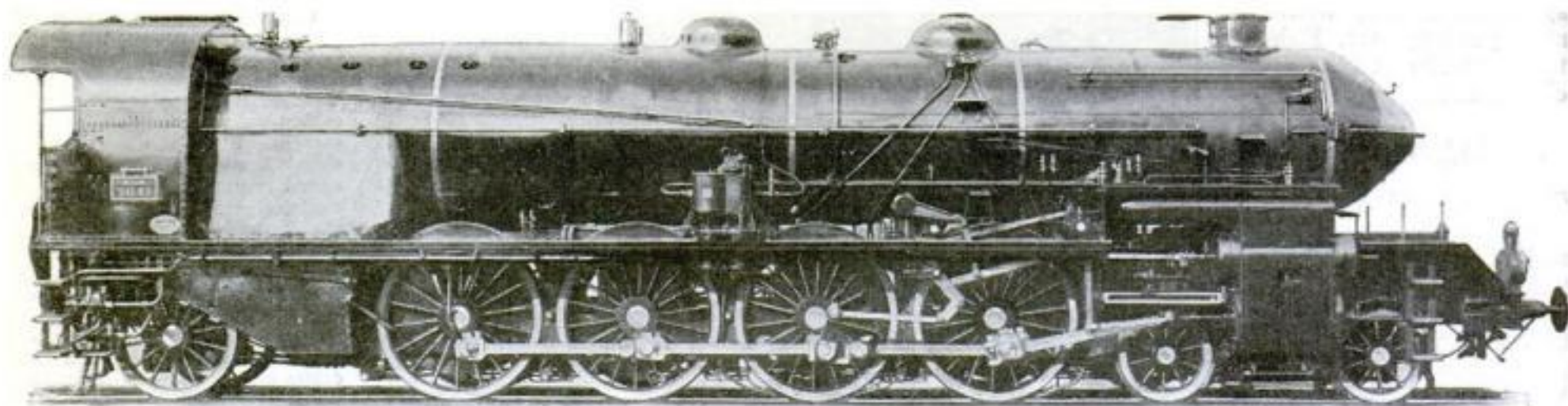
Criminals as a class are as intelligent or more so, than the rest of the world,

(Continued on page 114)



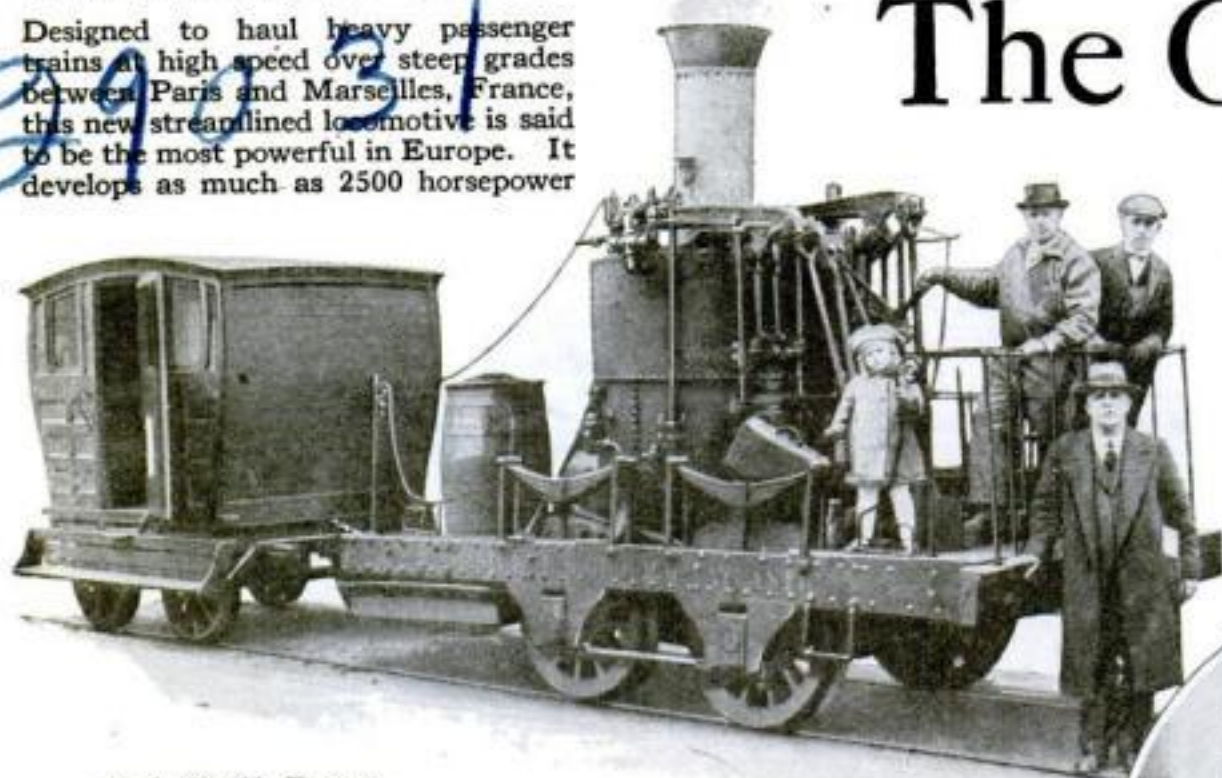
Odd Snakes from Africa Arrive at Zoo

Officials and keepers at the Bronx Zoo, New York, had an exciting five hours recently when a large shipment of snakes, including deadly black cobras, mambas, and pythons, arrived from West Africa. Doctor Raymond Ditmars, curator of reptiles at the zoo, is shown, here with a group of harmless ball pythons. When frightened, these snakes roll themselves up in a ball for protection from intrusion.



French Mountain-Climber

Designed to haul heavy passenger trains at high speed over steep grades between Paris and Marseilles, France, this new streamlined locomotive is said to be the most powerful in Europe. It develops as much as 2500 horsepower



The Old and New in Engines

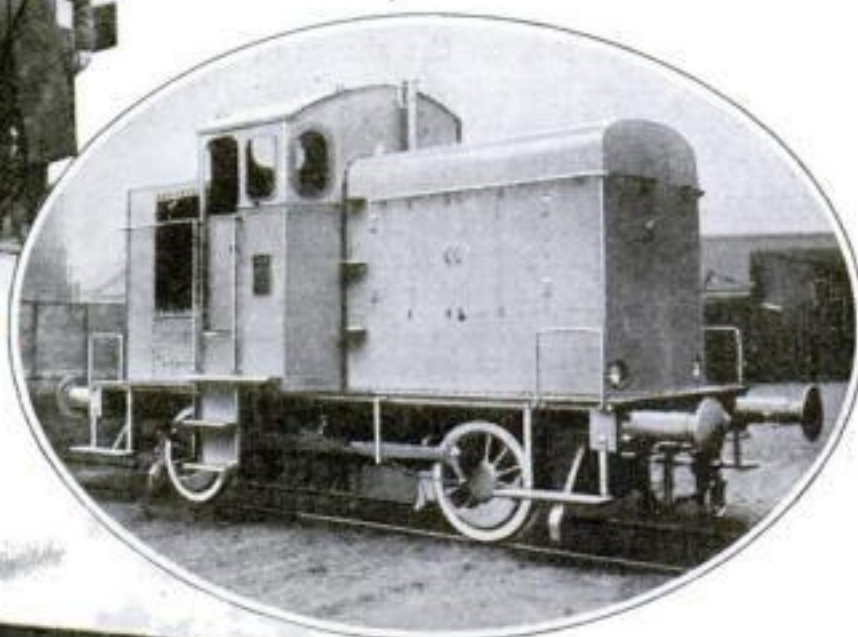
*Remarkable Advances
in Locomotive Design*

—and Still Runs

Nearly 100 years ago President Andrew Jackson adjourned a Cabinet meeting to see the *Atlantic*, the first locomotive that ever puffed into Washington, D. C. Today this old-timer (above) is still able to run under its own steam. It was built by Phineas Davis of York, Pa.

Runs by Batteries

Storage batteries supply the driving power for the *Baden* (at right), a new type of Diesel electric locomotive developed in Germany. It is said to have tremendous pulling power.

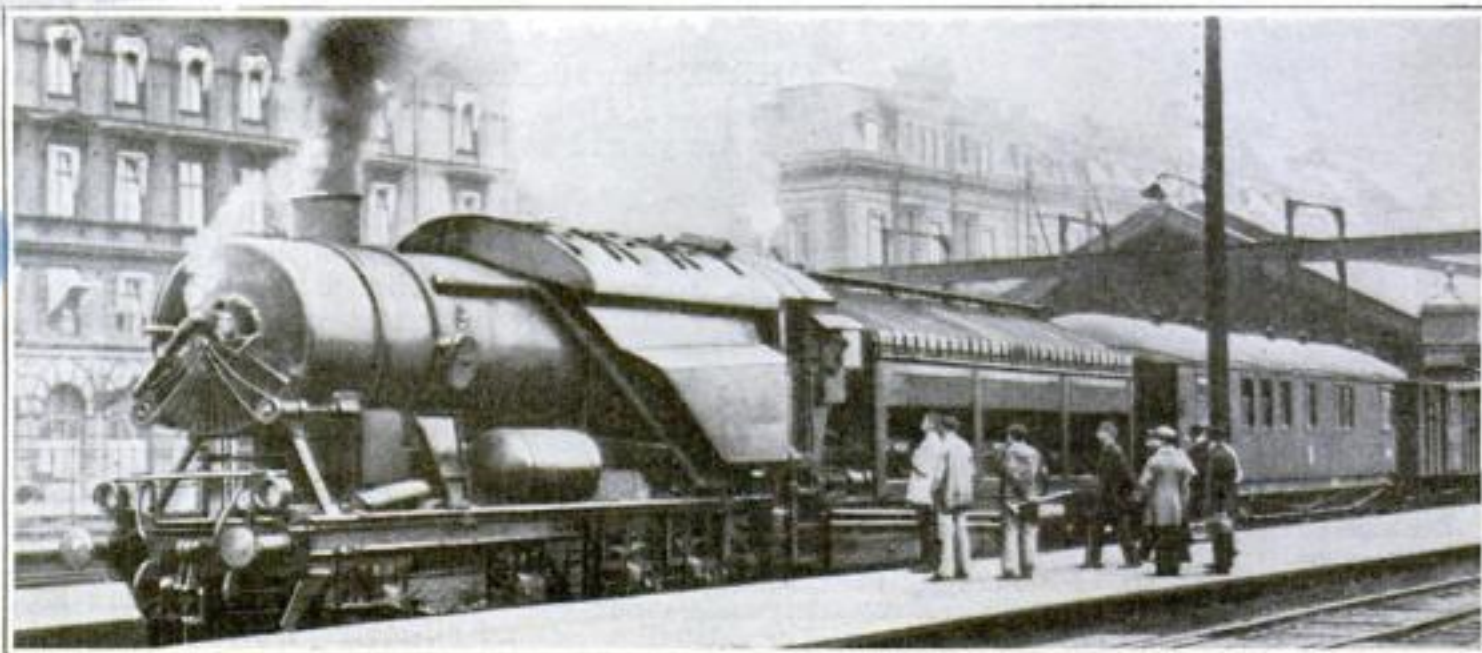


Trackless Train

What is declared to be the world's first trackless train (left) recently completed a run from New York to Los Angeles, Calif. Locomotive and sleeping-car roll on automobile wheels

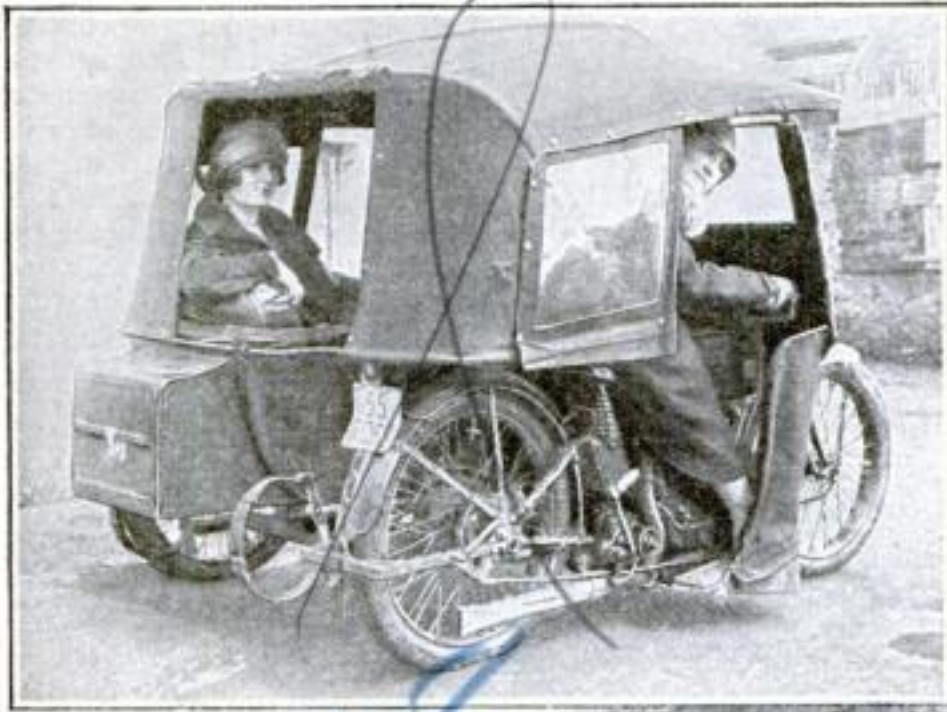
Railroad "Camel"

In recent tests on the Swedish state railways between Stockholm and Gothenburg, a new type locomotive called the *Camel* (right) is said to have consumed less than one-twentieth as much water and 40 per cent less fuel than used by the ordinary locomotive. It has a special condensation apparatus invented by Fredrik Ljungstrom, a well known Swedish engineer



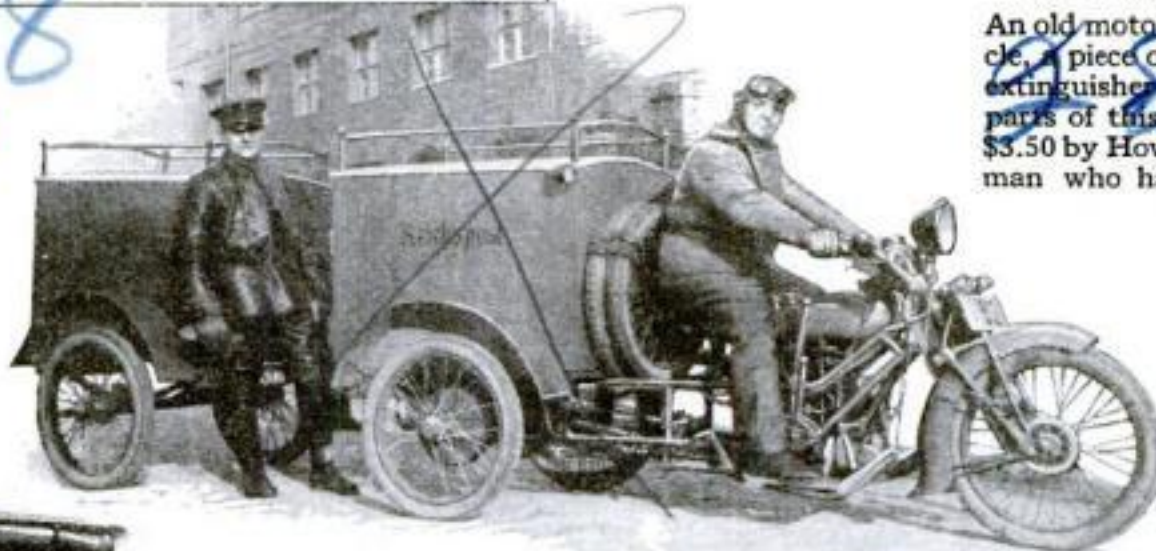
Oddities of Motordom

Ingenious Creations in Gasoline Cars



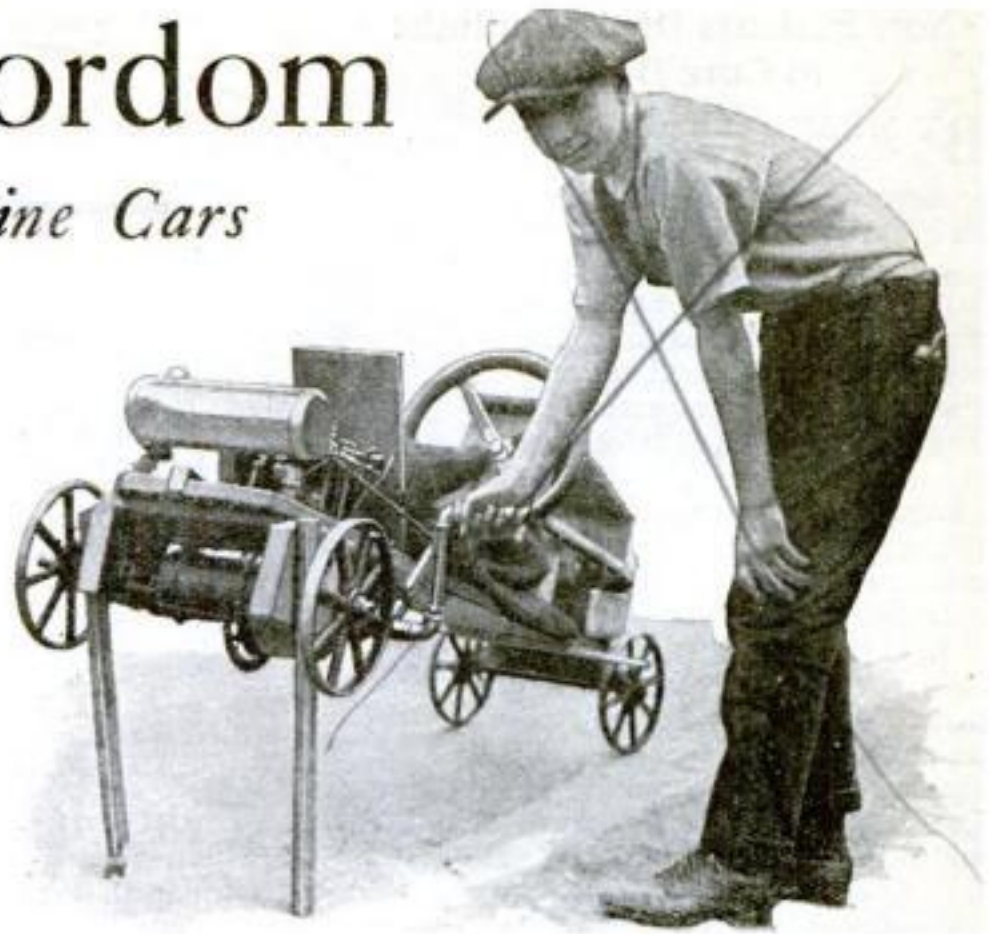
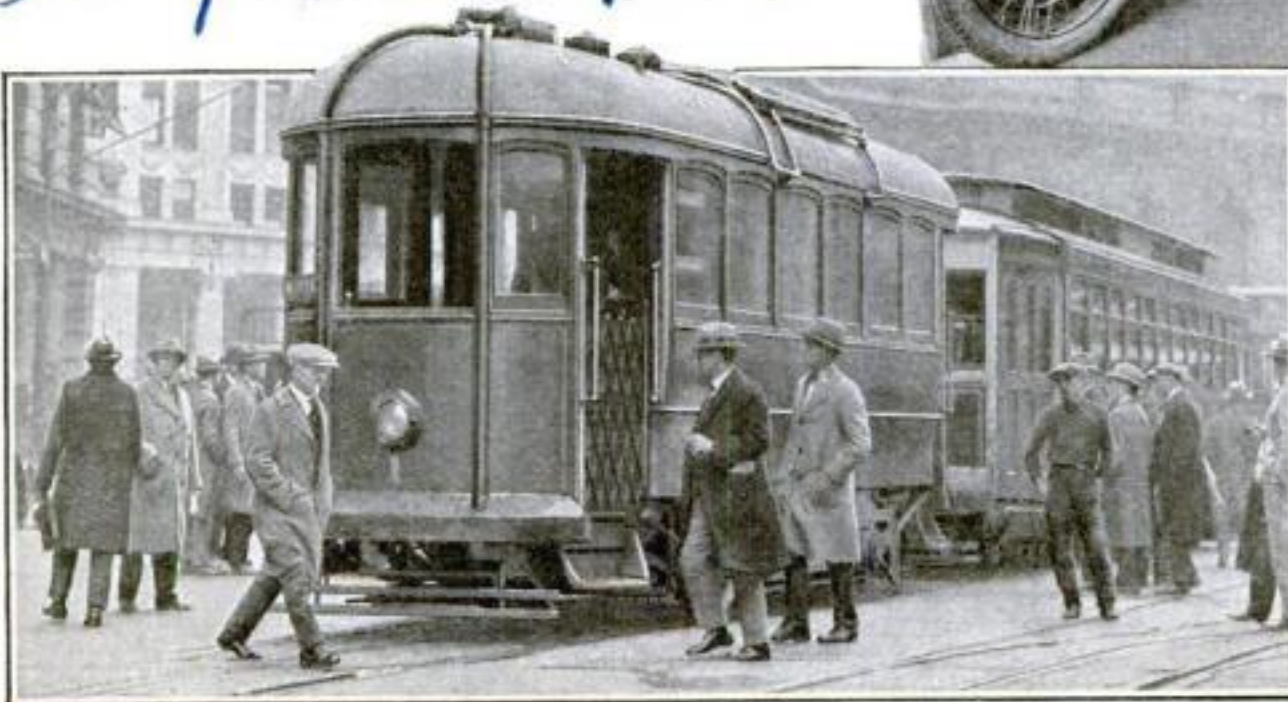
Cycle Sedan

A Roman sportsman, a motor enthusiast, saw no reason why cyclists should not have as much protection as occupants of a closed car. So she designed this ingenious top that covers both the motor-cycle and its sidecar



Novel Freight Taxi Appears in Paris

This light and speedy freight taxi is a recent innovation in Paris, France. It delivers packages and bundles for anybody, anywhere in the city. Delivery charges are determined according to the mileage readings on a meter



An Automobile for \$3.50

An old motor once attached to a bicycle, a piece of water-pipe, an old fire extinguisher and four small wheels are parts of this remarkable car built for \$3.50 by Howard Schulenberg, a young man who hails from Portland, Oreg.

New Mail-Car

A three-wheeled mail-delivery car of motor-cycle type (left) recently was adopted by the German Postal Service. It hauls a small two-wheeled trailer for carrying heavy mail-sacks



Midget Motorcycle

The little fellow must have one like dad's. This time a German manufacturer has made for him the smallest motorcycle. It weighs only 30 pounds, yet is equipped with everything that goes on a full size machine

Gasoline-Driven Streetcar

A remarkable gasoline-driven streetcar (at the left) recently was put in operation in New York City. While it carries its own passengers, it also serves if it is necessary as a power car for the ordinary streetcar trailer

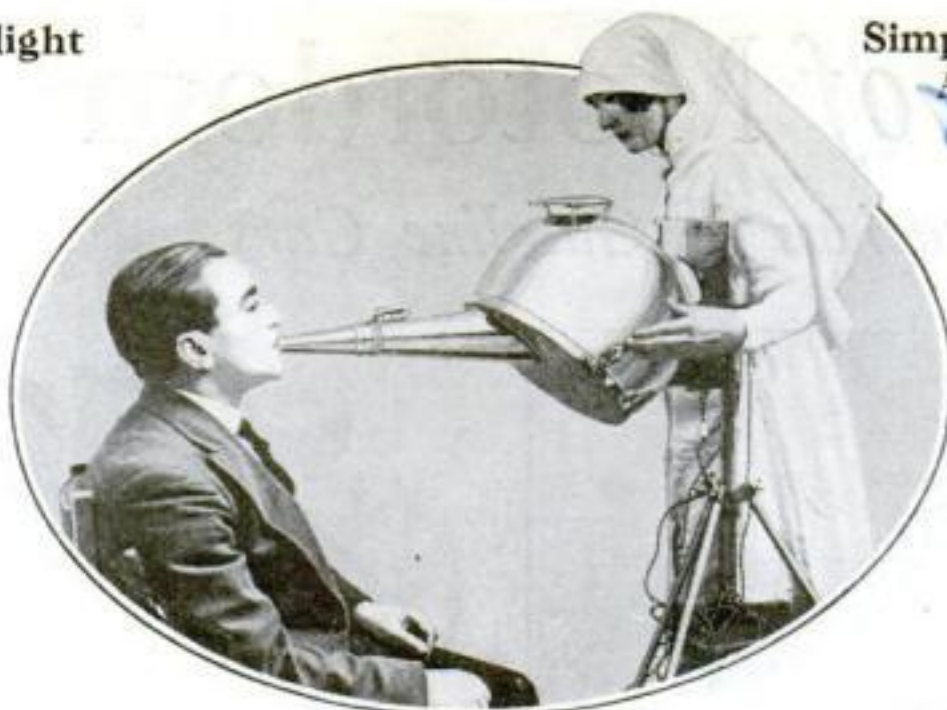
Now Patients Drink Sunlight to Cure Disease

BY MEANS of a new ultra-violet-light machine the curative powers of sunlight can be administered internally.

Sunlight long has been used in the treatment of numerous diseases—in fact, it is one of the oldest and most effective medicines, but to a great extent its use has been limited to certain diseases. The scope of this natural curative power, through the use of this ultra-violet-light machine, it is claimed, will be enlarged greatly.

Used in the mouth and throat, it is reported to have proved beneficial in cases of several diseases. The machine was shown recently at a nursing exhibition in London, where it drew much attention and favorable comment.

How ultra-violet light is administered internally with the new machine



Lightning-Rods for Trees

SO SUBJECT are trees to being struck by lightning that the rodding of valuable trees to protect them from possible destruction is advised by tree experts of the Department of Agriculture.

Studies in various localities have shown that the oak is struck by lightning more often than other tree. The elm, ash and poplar also are susceptible.

"Radium Chain" for Cancer

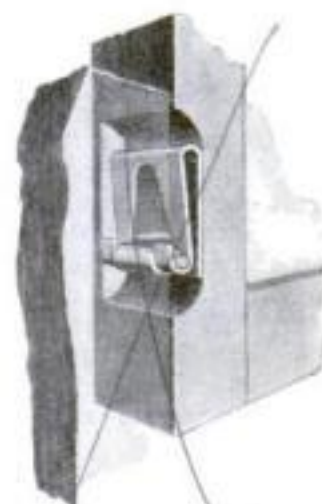
AN ASTONISHING new treatment for cancer by "radium chain" recently was described by Dr. Sidney Yankhauer of New York City. The chain he said, is made of three platinum links, with capsules containing radium emanations. These are incased in rubber and weighted with a gold ball. The chain is swallowed by the patient and kept in the intestines several hours a day.

Simple Window Support Does Away with Sash Cords

A NEW device for supporting windows in any position, without the use of sash cords, weights, or pulleys, accomplishes its purpose through a roller and a supporting bracket made of spring brass.

The bracket is attached to the sash and carries the roller horizontally when the sash is being raised. One end of the roller is confined, while the other has a slight play, allowing it to assume a slanting position from the force of gravity on the sash. The resulting friction, it is claimed, is sufficient to hold the sash in place, but yields readily when the window is pulled down.

The spring construction prevents rattles and holds the sash tight. Two of the supporters are used on each side of a sash weighing not more than 15 pounds. For heavier windows more of the supporters are used. The device is said to be less expensive to install than are the usual weights.



Section view of sash, showing supporter

Fuel-Saving Smoke-Consumer Made of Scrap Iron



ANY plan or device to keep the air of cities fresh and clean in this day of manufacturing and industry seems certain to have an immediate value. Engineer Fred Kammer, of Cincinnati, has contributed to modern invention a smoke-consumer designed to serve also as a fuel-saver.

The device is constructed of scrap iron and, as the idea is carried out in a Cincinnati plant, consists of a system by which preheated air, admitted over the fires in the boilers, is said to bring about perfect combustion. Since their installation several months ago, the smoke-consumers are reported to have saved about 40 tons of fuel for the plant.

The picture shows Engineer Kammer standing beside a boiler equipped with one of his fuel-saving smoke-consumers.

Cork Houses in England

COMPRESSED cork, covered with 1½ inches of concrete, is being used in the building of houses at Deal, England. It is said to be fireproof and soundproof.

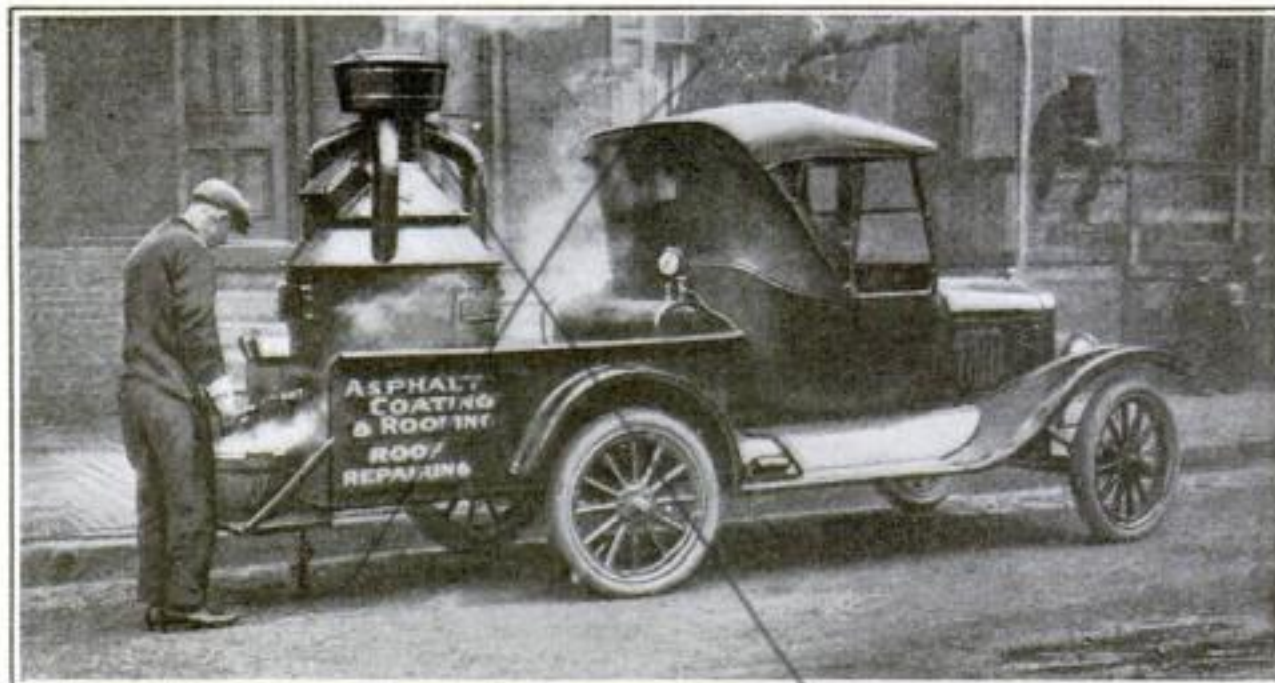
Roofing Plant Carried on a Small Truck

A ROOFING company of Reading, Pa., instead of using scrap wood as fuel for melting the pitch used in roofing, as most roofers do, has constructed on the rear of a Ford chassis a modern oil-burning heater. The lump pitch is put in through a door at the top of the heater and the melted pitch is drawn off at the bottom by means of a large spigot.

An oil-burner somewhat similar to those used in oil-burning house furnaces fits in

the bottom of the heater. A 60-gallon tank, placed behind the seat of the car, supplies the fuel oil. By means of a small hand pump on the dashboard, 30 pounds air pressure is maintained in the tank. Pumping is required only once an hour during the operation of the heater.

Labor costs are said to be reduced considerably by the oil-burning heater, and the burner is compact, easy to operate and clean.



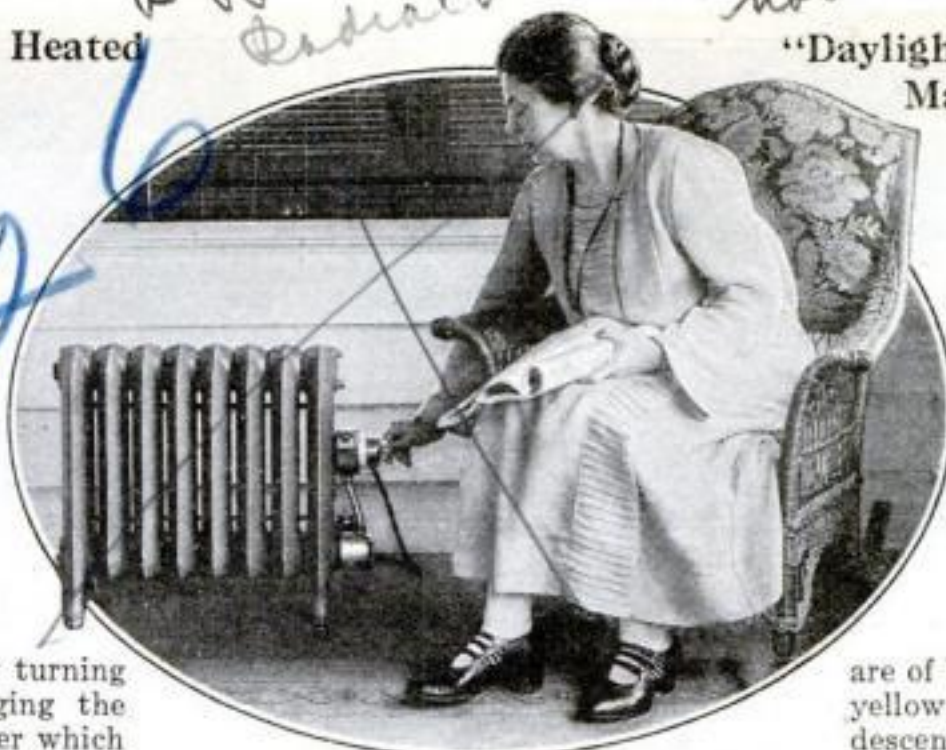
An oil-burning heater, mounted on a small truck, heats the pitch for roofing

Portable Steam Radiator Heated by Electricity

AN ELECTRIC steam radiator is one of the latest developments in modern heating for the home.

The heating element extends throughout the radiator in a protective seamless brass tube, which assures an even heat in every column and provides a large radiating surface for heating the water surrounding it.

Water is supplied through a filler cap in sufficient quantity to cover the heating element and current is applied by turning the switch to "High" for bringing the water to the steaming point, after which it can be turned to "Medium" or "Low."



Radiator can be used near any switch

"Daylight" Spectacles Invented for Matching Materials and Dyes

NO LONGER need a salesman take material to the window to show a prospective customer the effect in daylight; nor need he even turn on a special light. Instead, he soon will be able to hand the customer a pair of daylight spectacles, invented by Dr. Hermann Weiss of Vienna. Already the spectacles have come into wide use in laboratories in the textile, paper, and dye industries.

These daylight spectacles are of blue glass that absorbs some of the yellow rays in which the ordinary incandescent lamp is rich, but that are not present in such abundance in sunlight.

Safety Butt-Hook for Logs Prevents Accidents

SEVERE accidents sometimes occur in lumbering camps when logs dragged up steep hillsides become unhooked accidentally from the lines pulling them. Too, recovering the log means great loss of time.

A safety butt-hook recently invented prevents this accidental unhooking. Pressing a thumb latch opens a plunger sufficiently to allow the line passing around a log to be placed within the hook. The plunger then drops back to a closed position and the hook is locked automatically by a spring that forces the latch back to its original position.



Have you entered our
remarkable
\$10,000 Contest?
See page 29 of this issue of
POPULAR SCIENCE MONTHLY

Improved Metal-Cutting Tool

A NEW tool that cuts metal at higher speeds and in larger chips than practicable with standard tools was described to the American Society of Mechanical Engineers by its inventor, Dr. Hans Klopstock of Berlin, Germany. Tests made in foreign railroad shops, Doctor Klopstock claimed, indicate that production can be increased about 30 per cent by the new tool.

Shoemaker's Last Distributes Hammer Blows Evenly



THE shoemaker's last shown above is intended especially for the father of a large family who finds that the only way to keep his children well shod is to mend their shoes himself; but a professional shoe-mender, too, will find that it has its advantages.

It consists of two parts—the last itself over which the shoe is placed, and the support, with its wide, curved base that fits comfortably over the shoe-mender's knee and, by reason of its size and shape, distributes the shock of the hammer blows so that they cause no discomfort to the operator. One other improvement is the insertion of a rubber disk between the last and its base.

New Railroad-Crossing Guard

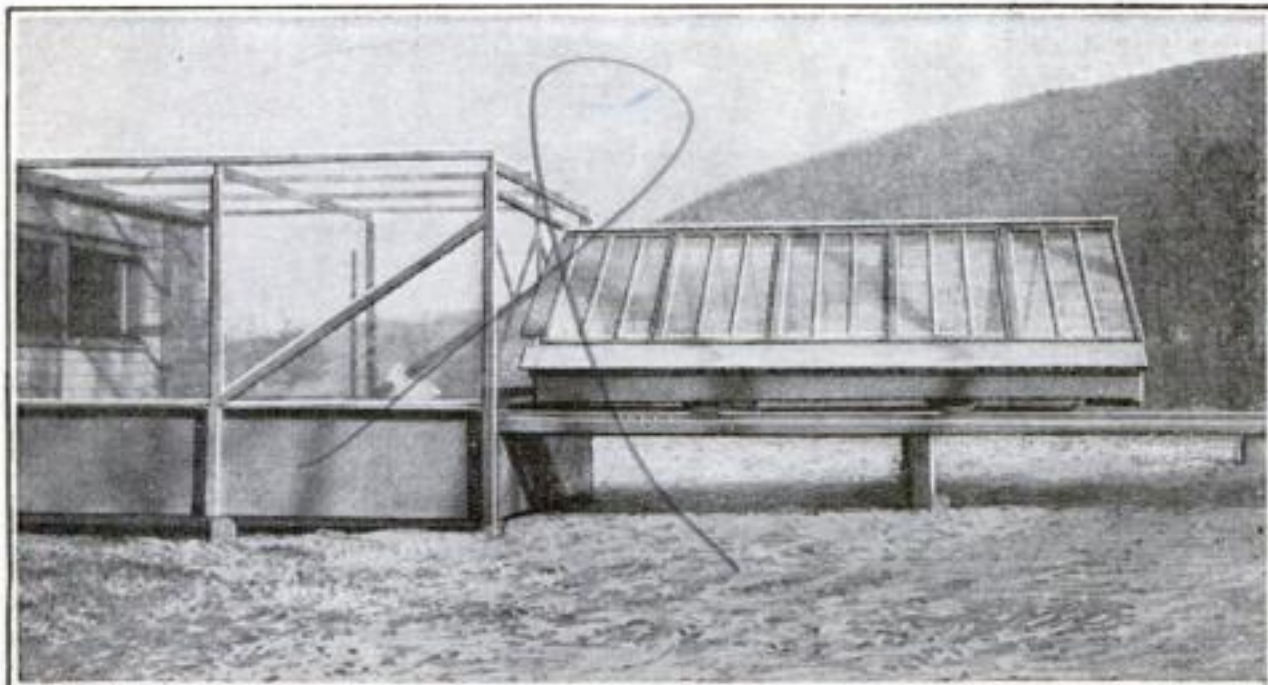
A SWEDISH engineer, A. Westfelt, recently invented a safeguard for railroad crossings. It consists of a bar, seven feet high, that swings out whenever a train approaches and short chains that strike any car passing underneath. The bar gives a driver warning 80 feet from the track. It is operated automatically by approaching trains.

Man Builds Sun Parlor for His Chickens

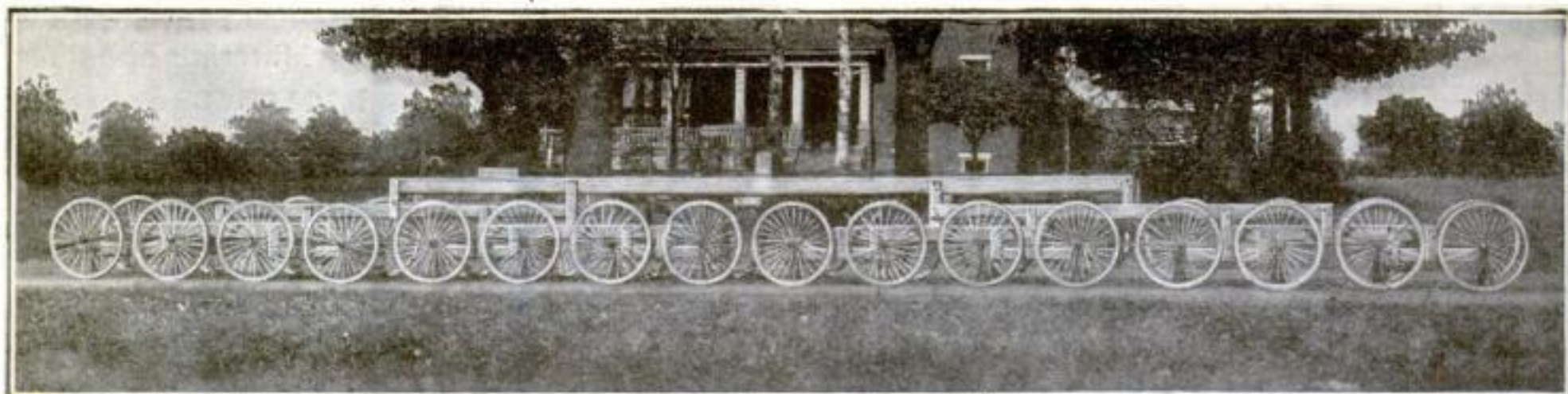
IN ORDER to take full advantage of ultra-violet light, which experiments have shown to have a decided beneficial effect on egg production, H. D. Goodale, of Williamstown, Mass., has constructed for his chickens a unique sun porch. A glass roof travels smoothly on a track and when the sun shines, the roof is slid out so

that the hens can get the full benefit of the ultra-violet or health-giving rays of sunshine.

When it is cloudy or raining, the glass roof is used for protection from the weather, and mercury-arc electric-light lamps are used to provide the hens with artificial sunshine.



How the sun-porch extension is built on an ordinary chicken-house



Smoothness of Illinois Roads Tested by Profilometer

IN THIS day of the automobile and the heavy truck, roadmaking has an important place in state and town business. It is important to find what materials and system of construction withstand best the wear and tear of local conditions.

It is for this purpose that Illinois employs the 32-wheel profilometer, il-

lustrated above. It is a most ingenious device. The 32 wheels are controlled from a steering-wheel, set just off center, by a stranded cable that is connected with each wheel and crosses at center, thus giving an even pull on all the 32 wheels.

A recording instrument, called the "strainagraph," indicates on a record sheet every unevenness in the newly made road,

in fact, the needle actually records the exact profile of a road, from crown to sides, including curves and grades. This machine enables the state to keep tabs on its road contractors.

Coal Sizes Standardized

HOUSEHOLDERS will be glad to hear that, beginning this year, the anthracite coal industry will standardize coal sizes. Elaborate systems of screening are being installed at the anthracite mines. Stove coal for the kitchen range will drop through holes exactly $2\frac{1}{2}$ inches in diameter, and nut coal for the furnace through openings one and nine-sixteenths inches in diameter.

Slate mixed with the coal will not exceed in weight from 2 to $7\frac{1}{2}$ per cent of the delivery.

Camera Photographs Stomach

AN INGENIOUS camera that photographs the interior of the stomach was displayed recently at Atlantic City, N. J. The apparatus consists of a metal tube that can be slipped down the patient's windpipe. At one end of the tube is a powerful electric light that illumines the stomach, and at the other end a special camera, with a series of lenses in between. The apparatus operates like a periscope, enabling the doctor to get a clear view of the patient's stomach.



New Egg Crate

FROM England comes a new way of packing eggs. It consists of a light metal frame latticed with double cords that stretch from side to side. Light wooden partitions are threaded on the cords. Each egg is placed carefully between the four cords and there held securely. This is said to reduce breakage.

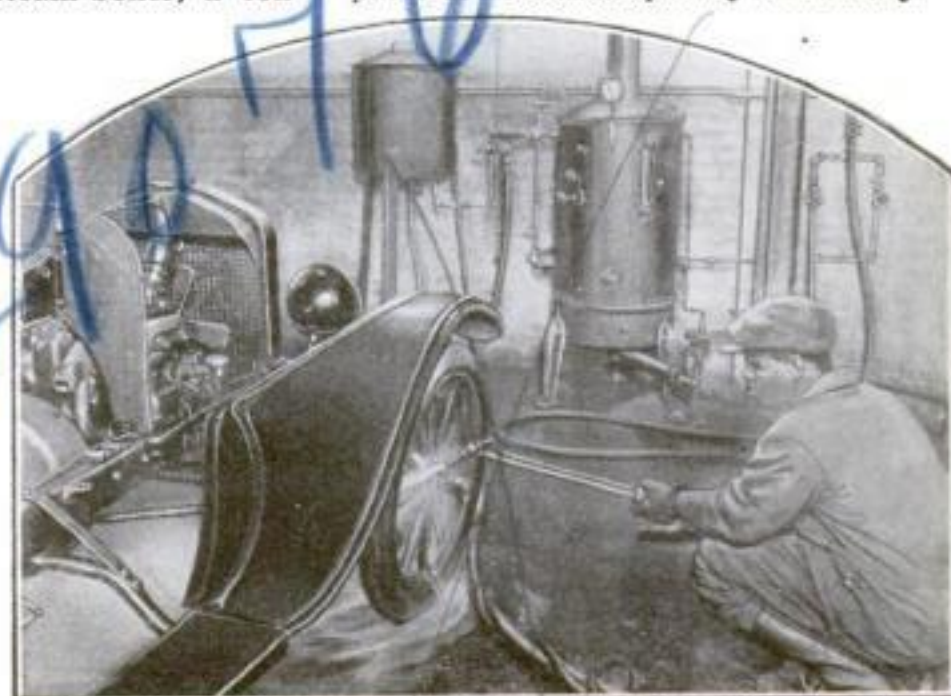
Gas Auto Cleaner Uses Fine or Heavy Spray

AGAS-FIRED auto cleaner, the invention of Garnet McKee of Rockford, Ill., is the newest device for automobile washing and removing paint or grease. It consists of a small steam-boiler, a container for the cleaning chemical, and a metal nozzle with two lengths of hose, one for carrying a high-pressure supply of steam; the other for delivering the special cleaning compound from the container. The compound is mixed with steam in the nozzle when power is turned on.

When cleaning only is desired, a weak solution under low pressure is used. When

paint or grease is to be removed, full-strength solution is said to remove all foreign matter almost instantly.

Almost inaccessible or complicated parts are reached quickly and easily.



Removing grease from a car with new steam-pressure apparatus

Know Your Car

A STARTLINGLY large amount of the gasoline that is poured into auto tanks is wasted through improper carburetor adjustment and careless methods of driving. Another large amount is wasted yearly through small leaks in the carburetor and gasoline piping. A tiny leak, just sufficient to keep the bottom of the carburetor covered with a film of gasoline, is often enough to drain the vacuum tank dry in less than a week if the car is standing idle.

Remember these rules if you want the maximum gasoline mileage:

- 1—Never adjust the carburetor when the motor is cold. Change the setting only after the motor is heated up thoroughly.
- 2—Keep the mixture as lean as possible without noticeable loss of power.
- 3—Never race the engine while idle and avoid jamming the throttle wide open unless it is absolutely necessary.
- 4—Coast long hills with the motor shut off entirely.
- 5—Do not use the brake except in emergencies. Learn to shut off the power and coast to a stop with just a touch of the brake for the last few feet.



Trailer Brake Is Controlled from Cab of Motor-Truck

A BRAKE that is said to give complete mechanical control of the trailer from the cab of the truck has just been developed by a Los Angeles trailer-manufacturing company.

The new trailer brake is in two units—one installed in or alongside the cab, and the other on the trailer frame, just behind the front axle. The two units have a cable connection for setting and releasing the trailer brakes. This cable connection can be disengaged between the truck and the trailer by means of snaps, thus per-

mitting the use of the truck alone or with another trailer, and the use of the trailer with another truck.

To set the trailer brakes, the driver operates a hand lever, closely resembling the hand brake on the truck. By pressing down with his thumb on the push rod, he engages a dog in the ratchet on the drum, making the hand-lever brake integral with the drum. Then, by pulling

back on the hand lever, he winds the cable farther around the drum and thus sets the brakes.

With this control the driver can alternate in the use of truck and trailer brakes on a long down grade, and as there is no need of running against low-gear compression as a means of braking, there is possible a distinct increase in the speed of transportation.

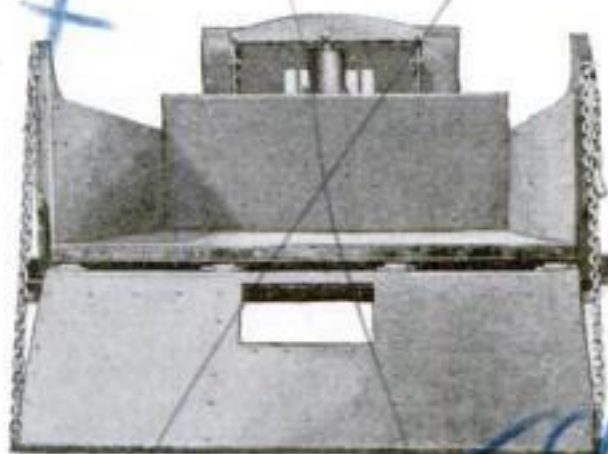
Motion-Picture Cameras Now Operated by Radio

MOTION-PICTURE cameras have been operated successfully by radio, according to reports from Universal City, California. A special device enables a camera to be placed at a point far distant from the operator and actuated by a transmitter.

This is expected to be of great value in photographing long landscape scenes—movie battles, for example, where several cameras have to be worked at the same time from different positions.

Another new use for radio is in overcoming the fog menace on the Great Lakes. Seven stations on the lakes will be fitted with radio equipment that will send out warnings.

Removable Truck Floor Permits Economical Replacement



IN LOADING rocks and other heavy materials, the impact on truck floors often not only leaves permanent indentations, but creates strains that in time distort the entire truck body. Floors of heavy armor plate resist the shocks, but

the expense and weight of material of this thickness are too great.

A manufacturer recently constructed a removable floor for trucks that is said to have great resiliency, and prevent trucks from being damaged. A layer of heavy creosoted planking is laid on top of the original steel floor. On top of this there is a protective covering of steel plate. The whole is bound together by flat-headed bolts.

New Method for Reviving Asphyxiation Victims

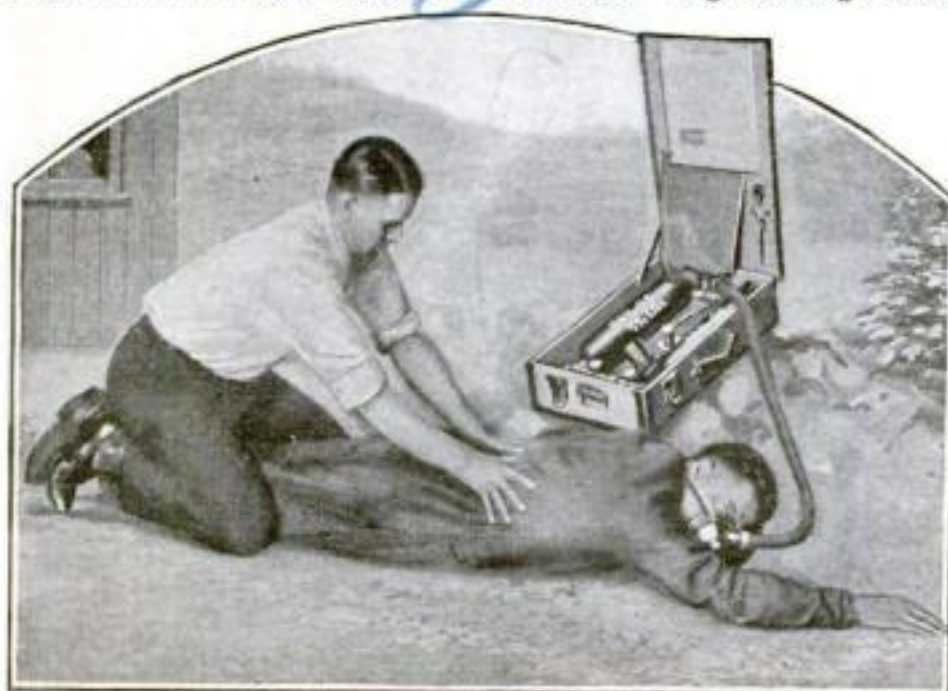
AN INHALATOR device for administering to victims of asphyxia a mixture of oxygen and carbon dioxide (0.95 per cent; CO₂ 5 per cent) called "carbogen," is the result of much study and research

work by Drs. Yandell Henderson and Howard W. Haggard.

The new device differs from other resuscitating devices in that natural breathing is brought about by the use of carbon

dioxide, which is Nature's own means of stimulating breathing. Oxygen, when administered with a small amount of carbon dioxide, causes the patient to breathe more deeply and rapidly, thus consuming large amounts of oxygen, that flush from the blood any volatile toxic substances.

It is claimed that the inhalator gives the patient every chance of recovery without danger of pneumonia.



Reviving an asphyxia victim with the newly invented apparatus

How Much Do YOU Know about Science?

THE following 12 questions, each relating to some fundamental fact of science, were selected from hundreds of queries sent in by the readers of POPULAR SCIENCE MONTHLY. How many of them can you answer correctly?

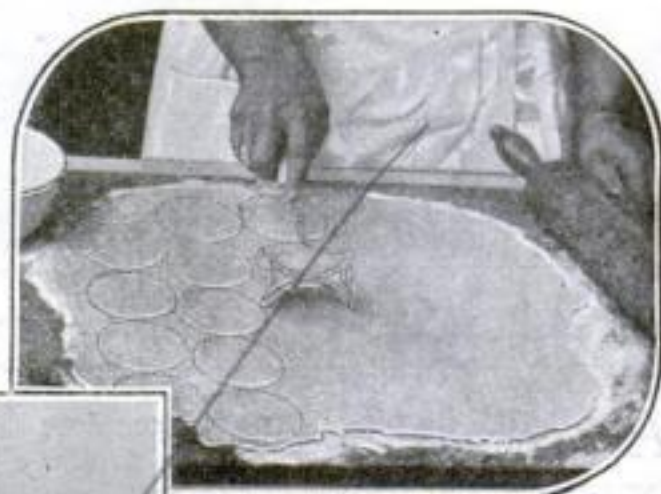
Turn to page 116 and see how nearly you were right.

1. Why is it poor policy to cover the ice in the refrigerator with paper?
2. What is the highest temperature a person can stand?
3. Why can people who apparently have been drowned be revived by artificial respiration?
4. How can a bat fly in the dark without hitting anything?
5. Why does the moon seem to follow you if you watch it while you are walking?
6. What makes ocean currents?
7. Why do colored clothes sometimes fade in the sunlight?
8. How are electric signs worked that are made up of moving lights?
9. Why must the ground wire of a radio set be fastened to the water-pipe rather than to the gas-pipes?
10. Why do some flowers close up at night?
11. What does fear do to your liver?
12. Why is yawning catching?

New Household Aids for Improvements in Laundry, Kitchen,

One Teaspoon at a Time

After filling the inner section of this tea-caddy with tea, it is placed in an outer section and the cone top illustrated at the left is adjusted. Once this top is in place, the caddy will give exactly one teaspoon of tea at a time; no other measure is needed.



Speedy Cookie-Cutter

In spite of its simple shape, the cookie-cutter shown above is a hard worker. Once the dough is rolled, the cutter will cut a whole row of cookies in a second—its makers say "86 cookies a minute." The blades are made detachable.

Iceless Refrigerator

An evaporator fitting into the ice compartment and run by water power, changes an ordinary icebox into an iceless refrigerator. The water motor may be set in any handy corner near by. A compartment in the evaporator freezes puddings, ices or liquids.



A Compact Laundry

For apartments where space is limited, a laundry outfit that can be attached to an ordinary sink has been devised. All the implements necessary for washing clothes are arranged compactly, ready for use. The clothes are hung on rods to dry.



Portable Dishwasher

This dishwasher requires no electric, gas, or water power to run it. After the dishes are placed in the wire holders, soapy water first is turned into the washer, the cover put on, and the handle turned. After rinsing, the dishes may be left in the racks to dry.



Spring Bottle-Cap

Once this cap is adjusted on a bottle, it will remain until purposely removed. The cap fits in the slots on the bottle neck. Inside the anvil-shaped piece is a flat rubber stopper that is forced firmly over the mouth of the bottle.



Electrically Heated Cup

Shown above is a cup containing its own heating element, that will quickly heat any liquid, such as soup, milk, or water. Merely sliding the cup on the stand serves to make connection with the source of current.

Nine Tools in One

This tool will pull tacks, scale fish, adjust gas-burners, open bottles and cans, serve as a stove-lid and hot-pan-lid lifter, may be used to make a tough steak tender, or as an ordinary tack-hammer.



the Modern Housewife and Bathroom Make a Shining Home

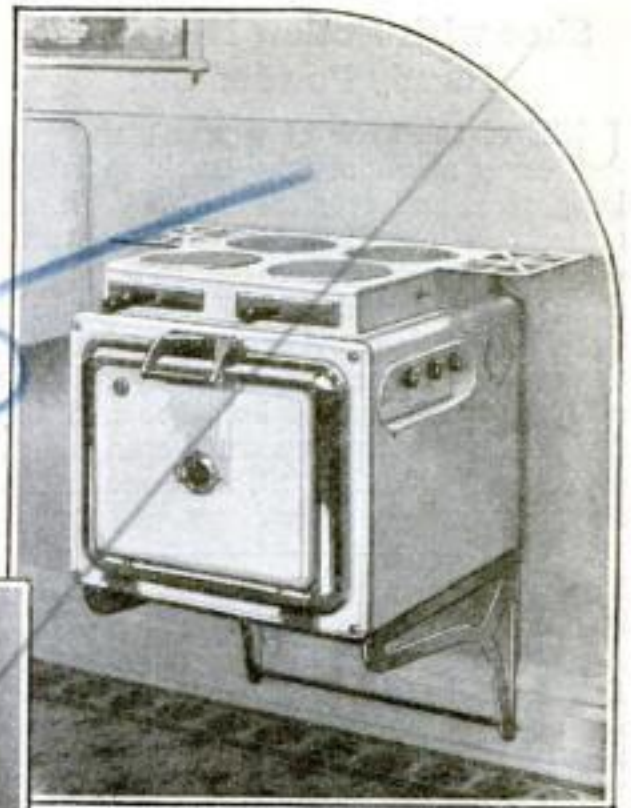


Adjustable Shelves

By means of the fixtures shown above, shelf brackets can be moved at half-inch intervals to accommodate utensils of different heights

A Folding Bathtub

Useful for any one without a private bath, this folding bathroom, illustrated at center and extreme right, is contained behind a screen and consists of a folding tub, water-storage tank with heaters, a basin, chest, and stool. When not in use the tub folds up over the tank



A Hanging Oven

The chief advantage of this electric oven hung on a bracket is that it can be placed wherever it is most convenient for the housewife, and, too, there is no trouble in keeping it clean



Opener for Flat Tins

Every one has had trouble opening tins such as contain shoe-polish. The opener shown above is used by placing one of the flanged rings beneath the tin, the other over it, then pressing, and the tin opens easily, and without bending its edge



Shoeblack Stand

Compact and complete, the neat little shoe-polishing rack will not look amiss in bedroom or bathroom. The extension can be adjusted to two heights and besides a compartment for brushes, there are rollers for the polishing rag to run through

Folding Ironing-Board and Seat

Illustrated below and in two pictures at right is an ironing-board with a seat attached, both of which will fold up into comparatively small space. The top of the board is adjustable for a left- or right-handed operator, and is fixed in place by a turn of a thumbscrew



New-Style Hand Brush

In the picture above is shown a new style of hand scrubbing-brush. Besides the usual flat surface there is an indented end made especially for scrubbing the fingers individually. Nails are cleansed by rubbing them back and forth over the brush



Shoe with Hollow Heel Holds Handy Powder-Box

USE of the heels of women's shoes to carry small articles, such as latch-keys, pins, and even small change, is not entirely a new idea. But now there comes from London an odd new type of shoe with a hollow heel that serves as a powder-box. Whenever the wearer wishes to powder her nose, she simply releases a catch at the back of her shoe and the powder-box heel swings down on a hinge, giving access to the puff, as shown in the illustration at the right.

IF YOU treat fish ponds as pastures and fertilize them, you will catch more fish. A lecturer at the University of Munich, Dr. H. Fischer, gives this advice, based on recent experiments. He obtained the best results by using phosphate fertilizers. When potash salts were used, it was found by the investigators that the increase of fish was not so great.



The hollow heel swings downward on a hinge, giving access to the powder-puff

Four Veterans See the World in Auto Home

AN INTERESTING round-the-world motor trip that began in 1921, was completed recently by Albert Carter, Goebel Reeves, "Piggy" Parks, and Jimmy Rogers, disabled ex-service men, in one of the oddest machines that

ever hit the "gipsy trails" of the world.

On a Ford chassis a small, houselike structure was built, affording comfortable living quarters for the tourists. As they journeyed from place to place, the four travelers tacked license plates, posters, coins, stamps, and other souvenirs on the walls and roof of their conveyance. These bear evidence of the out-of-the-way places they have visited. The car has penetrated practically every civilized country in the world.

The ex-service men passed through New York on their way to the New England states and to Boston, where the car will be placed on exhibition for two years and then sent to the Free Museum at Washington, D. C., as a memorial to the disabled veterans of the World War.



Odd round-the-world car, plastered with souvenirs

Family without Fingernails Discovered in Italy

A FINGER- and toe-nail-less family of women was discovered recently by the scientist, J. A. Pires de Lima. For three generations no woman in the family has had a full-fledged finger- or toe-nail. The investigations of de Lima show that in every other way the women are normal and healthy. Their seven brothers have full sets of healthy nails.

Of three finger-nail-less daughters, one has been married and produced daughters who are also without finger- or toe-nails. Doctor de Lima has reached the conclusion that this peculiar condition of the finger-nails is transmitted from mother to daughter as a result of an unusual case of sex-linked inheritance.

Novel Cigar-Lighter Made like a Telephone



A NOVEL cigar-lighter, invented by Sidney Stocking of Herscher, Ill., is made to resemble a telephone. The receiver is a gas torch. When this is lifted from the hook, a valve is opened releasing a flow of gas that ignites automatically.

The device is made in the shape of a desk telephone, as well as the wall style.

Steamer Built to Submerge

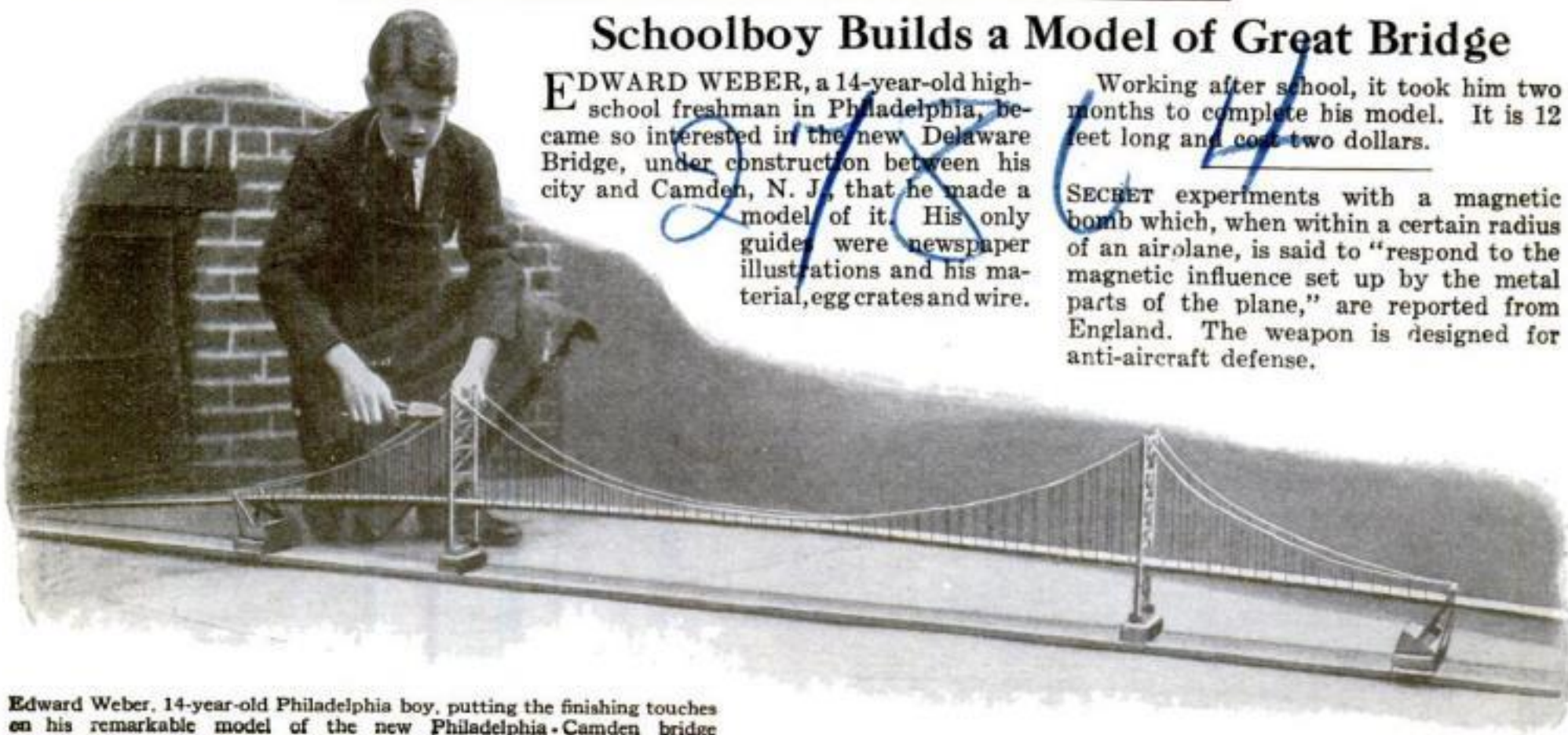
LOW bridges that span the River Spree in Germany interfere with the passage of excursion steamers from Berlin. For that reason, it is reported, a new steamer to carry 1000 passengers will be equipped with large tanks which, when filled with water, will submerge the hull sufficiently to pass under the lowest bridge in the river.

Schoolboy Builds a Model of Great Bridge

EDWARD WEBER, a 14-year-old high-school freshman in Philadelphia, became so interested in the new Delaware Bridge, under construction between his city and Camden, N. J., that he made a model of it. His only guides were newspaper illustrations and his material, egg crates and wire.

Working after school, it took him two months to complete his model. It is 12 feet long and cost two dollars.

SECRET experiments with a magnetic bomb which, when within a certain radius of an airplane, is said to "respond to the magnetic influence set up by the metal parts of the plane," are reported from England. The weapon is designed for anti-aircraft defense.



Edward Weber, 14-year-old Philadelphia boy, putting the finishing touches on his remarkable model of the new Philadelphia-Camden bridge

Fire Extinguisher Saves Pilot Five Miles Up

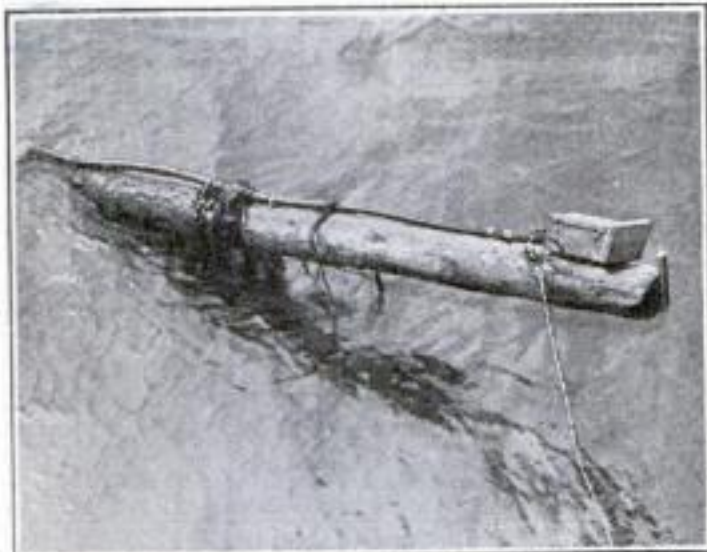
EFFECTIVE use of a fire extinguishing device nearly five miles up in the air recently saved the life of Captain Clauzat, a French altitude-record holder, when his plane caught fire.

When Captain Clauzat saw flames bursting from the hood, he seized an extinguisher and sprayed them until the fire was out. Later, in making a forced landing, flames again burst out and he had barely time to jump into the branches of a tree before his seat in the cockpit was enveloped in fire.

Harbor Telephone Station Used by Rum-Chasers

IN THE blockade of rum-runners off the Atlantic Coast the telephone, as well as wireless, has proved an important means of communication between government coastguard boats and officers on land. The picture below shows a novel sort of telephone station—a phone booth on the water—recently placed in Boston Harbor for use by rum-chasers. Its number is kept confidential.

The telephone instruments are inclosed in a small box fastened to the end of a log marker in the water. From the marker a cable runs under water to shore. When



the officer of a boat wishes to communicate with the shore, he simply runs his boat up to the log and puts in his call to the Boston Central.



Pressing the levers of this vending machine prints your name on the pencil

Machine Prints Names on the Pencils It Sells

A BORROWED pencil often fails to find its way back to the original owner. To make identification sure, and at the same time provide a handy means of purchase, a new vending machine has been designed to sell pencils stamped with one's full name.

By pressing various levers on the machine the purchaser sets his name up, letter by letter. The name can be checked for errors before turning the lever that prints it on the pencil. The machine holds about 300 pencils.

WHILE we are interested in the excavation of ancient cities in Egypt and far places of the world, we are finding some at home. The other day, C. B. Cosgrove, an American archeologist, discovered a buried Indian village on a ranch near Three Rivers, N. M. Two perfect rooms have been excavated so far. Skeletons were found in the smaller room.

Dentist's Traveling Office Serves Schools

TO PROVIDE expert dental service in rural districts, where otherwise it might not be available, a dental ambulance with skilled dentist and nurse is operated by the New Jersey Board of Health. With complete equipment, the dentist's traveling office pulls up to the door-steps of rural schoolhouses, where it is awaited by willing patients.

Black Tanks Waste Oil

BLACK cows are hotter than white cows. At least it seems so if one places his hand first upon the black then the white areas of a spotted cow standing in the sun. Recent tests have proved that the same thing is true of black-painted and white-painted oil tanks, and important use of this difference is being made in the petroleum business to prevent the evaporation loss of stored crude oil. In recent tests it was found that a tank painted aluminum or white, rose in temperature only 19 to 22



The traveling dentist in his office

degrees and lost only nine per cent of its naphtha content. If it was painted black, it increased in temperature by 54 degrees.

Army Mules Win from Truck in Tug-of-War

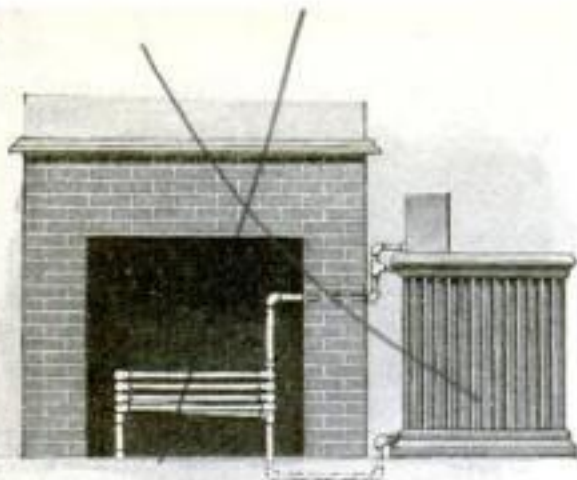
IF YOU were to stake the pulling power of 24 mules in a tug-of-war against a motor-truck, which would you say would win?

Such a tug-of-war actually was staged not long ago at Crissy Field, the Presidio, San Francisco. Twenty-four army mules,

tugging at their traces, pulled a heavy army truck down the field backward, while the driver of the motor-truck was "stepping on the gas" and trying to make speed ahead.



Twenty-four army mules are shown here winning a tug-of-war against a heavy army truck at Crissy Field, San Francisco, Calif.



How to Install a Hot-Water Heater in Fireplace

TWICE as much useful heat is said to be obtained from a fireplace with the installation of an ingenious system in which the fire is used to heat water-pipes. It is the invention of Martin Dodge, a former member of Congress.

The ordinary grate of the fireplace is replaced by a basket made of iron or steel water-pipes, in the form of a square coil, with an intake pipe at the bottom and an outlet pipe at the top. The outlet pipe leads to a steam radiator, located wherever it suits the convenience of the user. The pipe is connected at the top of the radiator. From the bottom of the radiator an outlet pipe leads to the intake of the fire basket.

At a level slightly above that of the top of the radiator, and connected with its intake pipe, is a water-tank. This, when filled, serves as an automatic pressure regulator.

When the fire is started in the basket in the fireplace, the water in the pipes is heated and rises, passing into the radiator and through it back to the bottom of the fire basket. Small quantities of water are added occasionally to make up for evaporation in the pressure tank.

Nothing is required to build this heater that is not found in an ordinary hardware store, the inventor says. The pipes and elbows are of stock sizes. Radiators of any size can be used and an ordinary bucket for the pressure tank.

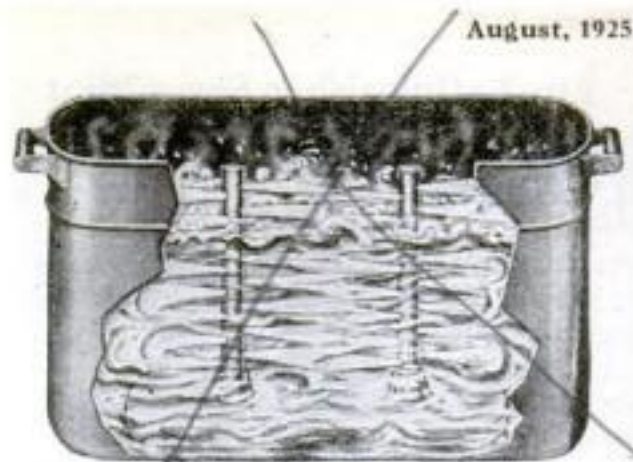
Selenium Protects Insulated Wires from Flames

DURING recent laboratory investigations at Cambridge, Mass., to find new ways to make insulated electric wires flameproof, it was discovered that selenium had great value in preventing the spread of fire along the insulation.

It was found that one part by weight of selenium protects 3.5 parts of cotton braid and 10 parts of rubber covering in the presence of 10 parts of copper conductor, contained in the usual No. 22 switch-board wire. Three milligrams of selenium thus protect a centimeter of length of wire, or one pound protects nearly a mile of wire.

On application of a flame, it was found, much difficulty is experienced in getting the insulation to ignite at all. When ignited, however, and the igniting flame is removed, the flame usually goes out without appreciable spreading.

The experiments were conducted in the laboratories of Arthur D. Little, Inc., in behalf of a wire and cable company.



This Device Turns Boiler into Washing-Machine

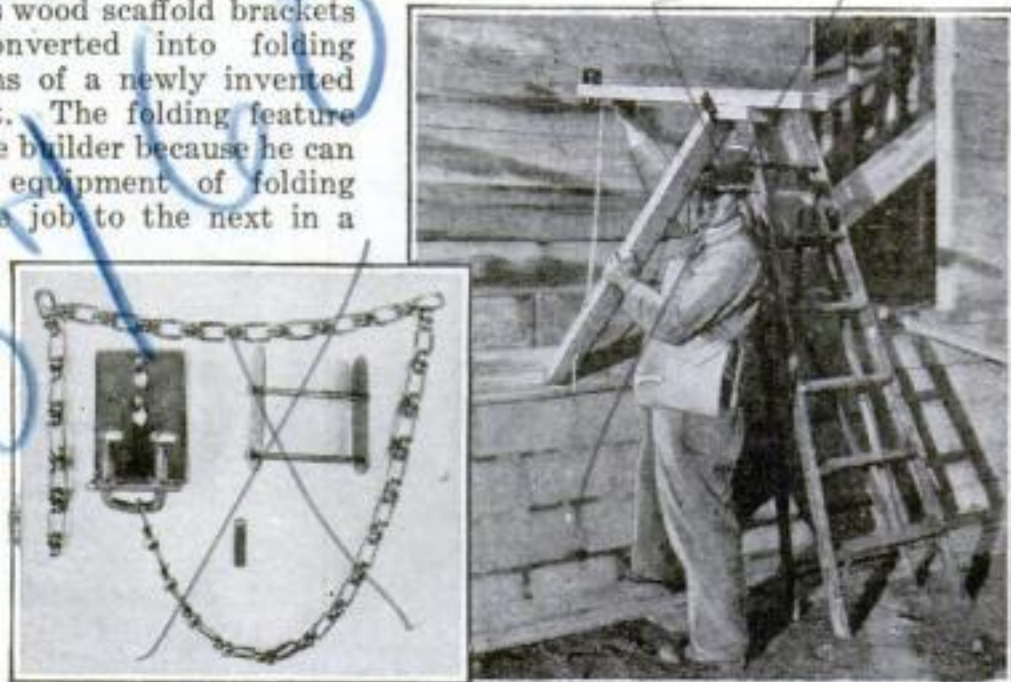
TO CONVERT a washboiler into a washing-machine, an ingenious device consisting of two upright cylinders on a base, and fitting into the bottom of any washboiler, recently has been invented. Each cylinder has 32 holes out of which soapy water spouts when the water is boiling and steam is generated. Its action is similar to that of a coffee percolator.

The soapy water forced through the holes flushes the dirt out of the clothes.

Folding Scaffold Brackets Aid Carpenters

ANY carpenter's wood scaffold brackets may be converted into folding brackets by means of a newly invented metal attachment. The folding feature is important to the builder because he can move an entire equipment of folding brackets from one job to the next in a single load and store them in space not much larger than that needed for a toolchest.

The parts of the attachment consist of a steel angle, a loose-hinged device, a length of light, strong chain, and a lock.



Folding scaffold bracket and (left) parts of which it is made

Now Tired Shoppers Can Wheel Their Bundles

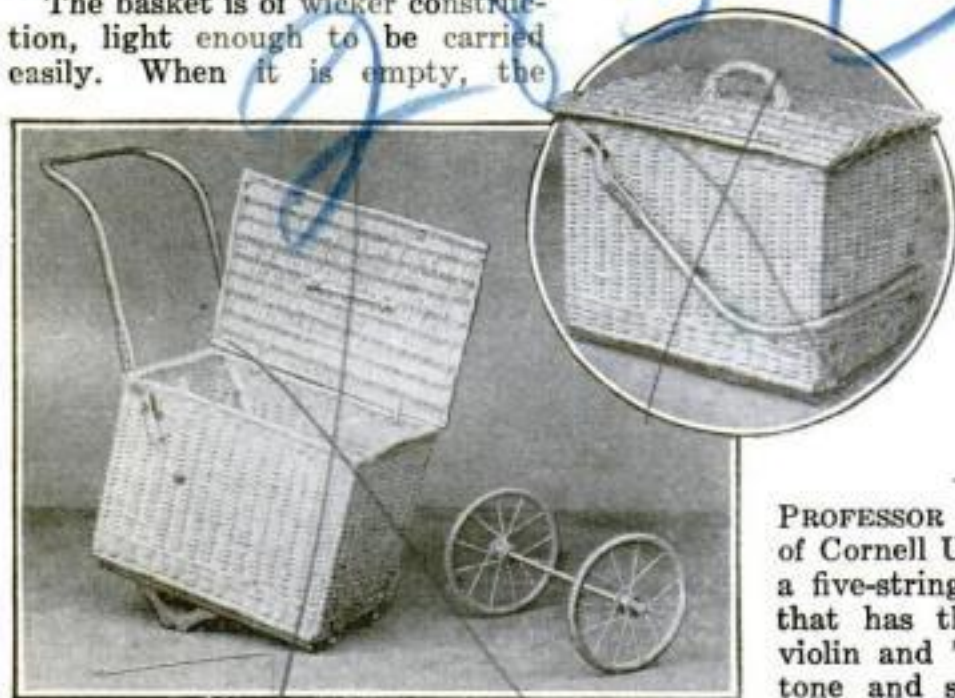
TO RELIEVE women shoppers of the bother of carrying bundles, a French inventor has designed a shopping basket which, when filled, can be wheeled like a baby-carriage.

The basket is of wicker construction, light enough to be carried easily. When it is empty, the

wheels of the carriage fit inside the basket and the handle swings down over the sides. A grip is provided at the top.

When it is to be filled with bundles, the wheels are removed and the handles swung back. Then the wheel axle is fitted and locked in brackets that are lowered at the bottom. The lid is locked down by the insertion of a pin through projecting loops, and the shopper is ready to wheel her purchases home.

PROFESSOR VLADIMIR KARAPETOFF, of Cornell University, has invented a five-stringed musical instrument that has the combined range of violin and 'cello. A fine depth of tone and shading are possible on this instrument, it is said.



How the basket is transformed into a carriage

Pure Silver Aluminum Made by New Process

PURE aluminum, the goal of many years of research, soon will be available in commercial quantities through the development of a new refining process. The term, "pure aluminum," is, of course, still a relative one, but its use certainly now is justified because the new process makes this metal with less than two one-hundredths of one per cent of impurity.

Previously, the purest aluminum ordinarily available contained 99.7 per cent of this metal. Some of the new product is as pure as 99.983. The principal impurity is copper, but traces of iron and silicon also are present.

Melted salts of sodium, aluminum, and barium fluoride are used in the process. The impure molten aluminum is carried by the electric current upward through the molten layer of these salts and is separated on top in a molten form from which point it can be poured or ladled off into molds.

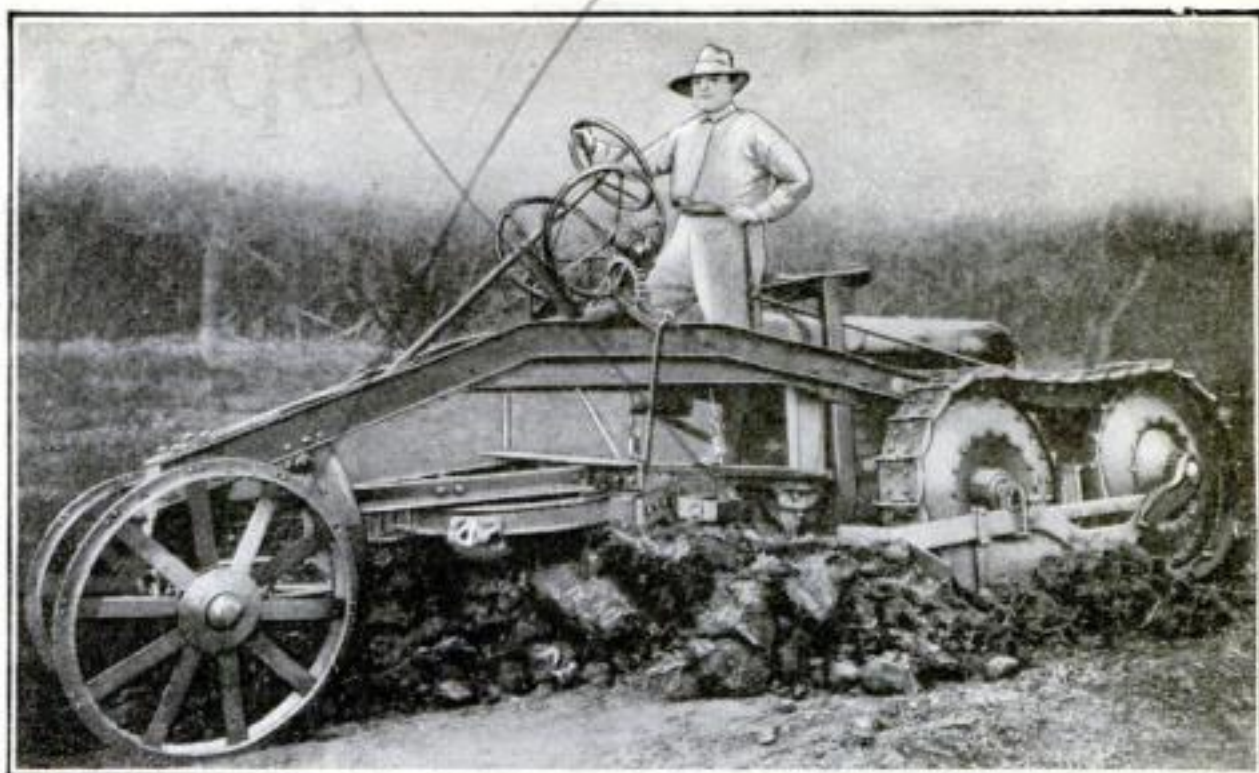
This pure aluminum has a beautiful silver color and luster which it is said to retain very well.

New Crawler Attachment Adds to Tractor Usefulness

A NEW crawler-tread attachment for tractors is said to permit the use of the machines under most difficult conditions—in sand, marshy lowlands, vineyards, orchards, and over rough, uneven ground. In oil fields, where the traction is unusually treacherous, this equipment, which greatly increases the ground contact, is reported to be especially useful.

The operation of the crawler attachment is independent of the tractor differential. Control is obtained through the use of two independently operating multiple disk clutches, one in each driving sprocket. This type of construction permits the full power of the engine to be applied to driving the track without imposing any strain on the tractor differential, which is locked.

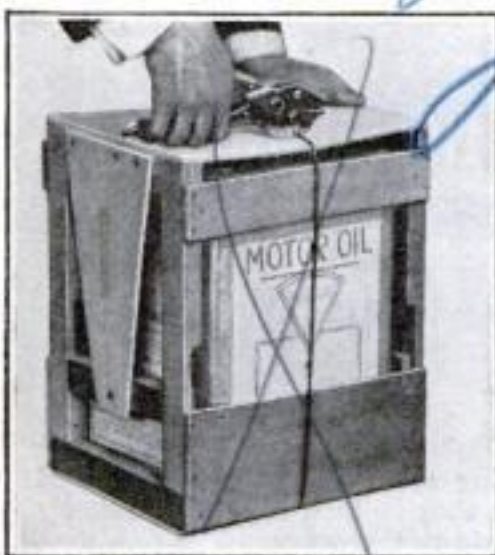
The attachment provides a tractive surface of from 900 to 1000 square inches.



Tractor with the new crawler attachment being operated on a plantation in Cuba

Oil Pouring Is Simplified by Tilting Crate

FOR five-gallon cans a new tilting crate serves both as a shipping container and a device to permit oil or other liquids to be poured from the can without lifting it.



How the cover of the crate serves as a support for tilting the can

The cover of the crate is designed with two side arms that serve as supports on which the crate can swing. When the liquid is to be poured, the crate and its contents are made to rest on these supports and tilted.

When the can fitting in the crate is equipped with a specially designed swivel spout, oil can be poured in small or large quantities with a minimum of waste and without soiling hands or clothing.

When used as a shipping case, the base is swung around to serve as a cover for the can.

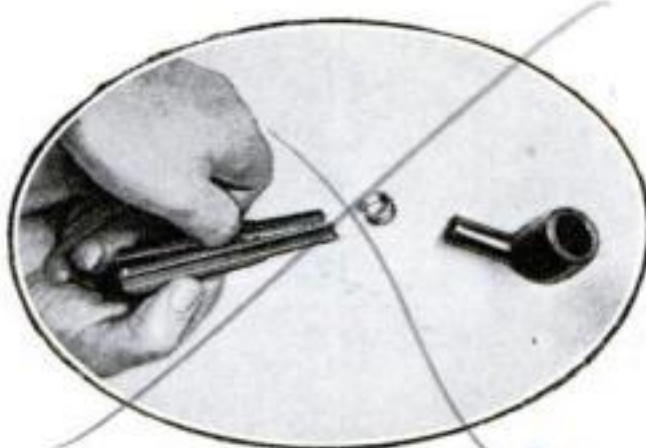


Ingenious New Ice-Box Makes Cold Out of Heat

AN ARTIFICIAL ice-box that is said to operate like a coffee percolator and to generate cold from heat has been invented by two young Swedish engineers, Carl Munters and Baltzar von Platen. When heated at one point, either by gas, electricity, or kerosene, it cools the usual kind of food-chest and for ordinary household purposes needs to be run only a few hours a day. When operated with gas at the Stockholm prices, it is said to produce the equivalent effect of eight pounds of ice at the cost of one cent.

The ice-chest has no movable mechanical parts. Operation is initiated by heat that sets an ammonia solution in motion in a small boiler. The ammonia then passes through condensation tubes. While trickling down a generator, it mixes with hydrogen and by evaporating absorbs enough heat to cool the food.

In a third cylinder, the ammonia is washed free from the hydrogen and then percolates through a set of tubes into the boiler again, where the heat once more sets it in motion. While this action is kept up, the refrigeration process continues.



Split Pipe Stem Can Be Taken Apart for Cleaning

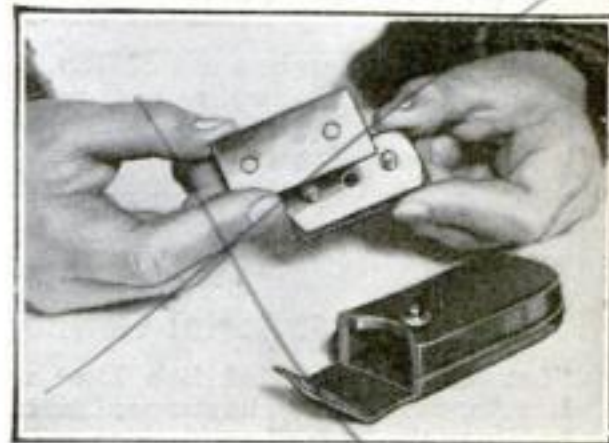
WITH a stem that is split in halves, this novel pipe can be taken apart easily for cleaning. The two parts are held tightly together by a decorative metal band that screws on a threaded part of the stem nearer the bowl. The makers of this new pipe declare the stem to be leakproof.

THE new 16-inch guns now being placed at the Panama Canal can shoot a projectile weighing more than one ton a distance of 27 miles once every 50 seconds.

Magnetic Case Designed to Sharpen Razor Blades

CONTAINED in a small case of pocket size, an unusual magnetic device is said to sharpen safety-razor blades by straightening the blades' edges. A blade fits between two pieces of wood and is slipped into the case, which has sides of highly magnetized metal.

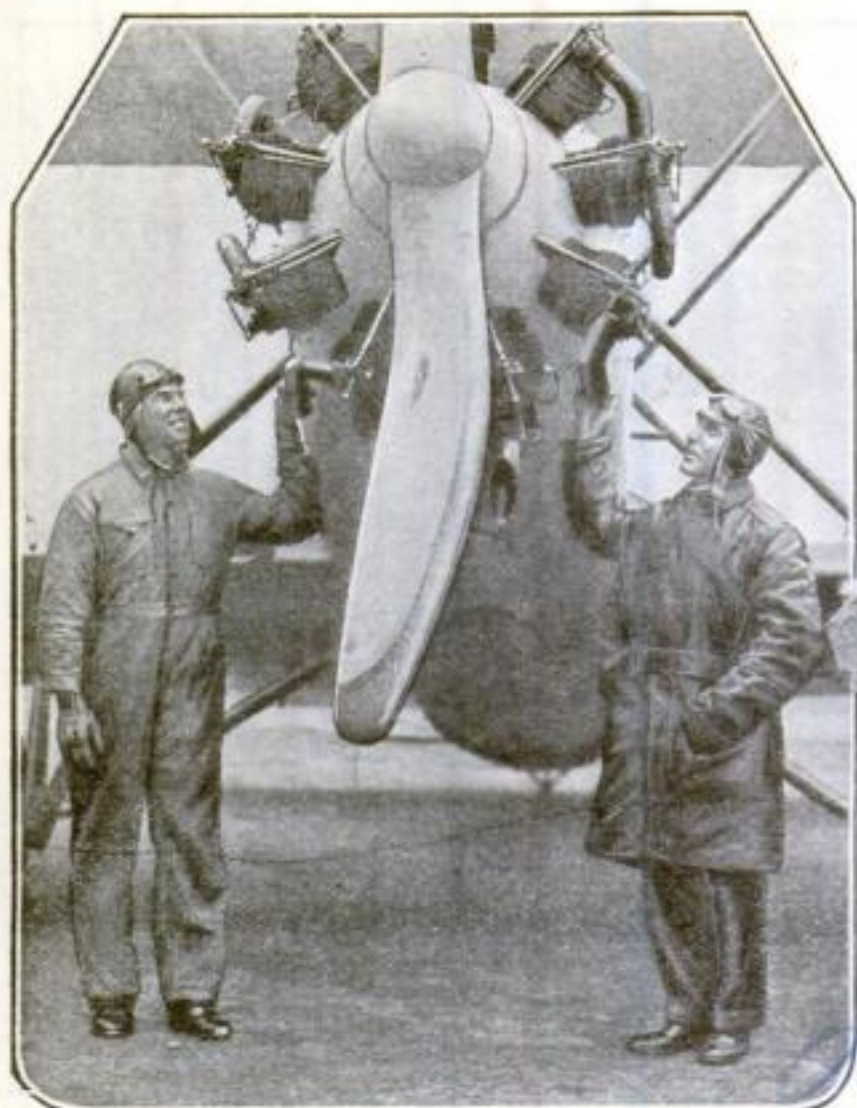
The metal, it is claimed, pulls the edges of the blade straight through attraction. Sharpening is done by leaving the blade in the case. If left there between shaves, the blade always will be ready for use, the inventor asserts.



Inserting razor in magnetic sharpener

Spectacular New

Mammoth Passenger Planes— Broncho Buster—Other



New Air-Cooled Motor

Driven by a new air-cooled motor (left), a navy torpedo plane recently completed a 230-mile test flight in 110 minutes—a record for planes of this type

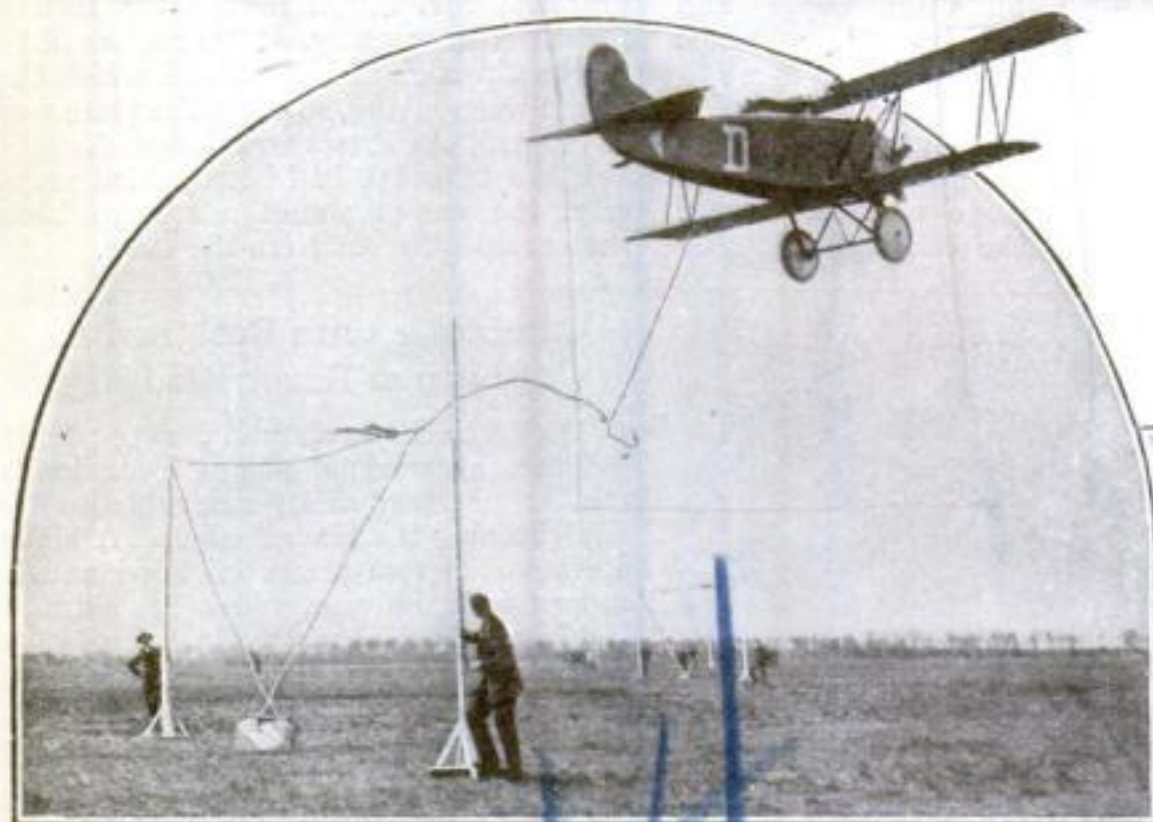
A "Flying Fish"

Because of its odd fish-shaped body, this eight-seater passenger biplane, recently constructed in England for commercial use, has been called the *Flying Fish*



Germany's New Air Wonder

So great is the wing spread of this steel-ribbed monster of the skies that 60 men can stand side by side from one wing tip to the other. The machine, a monoplane, will be used exclusively for commercial purposes. It is driven by three propellers, one at the center and one on each of the wings. Two pilots are needed to guide it. Despite its size, the monoplane accommodates only eight passengers

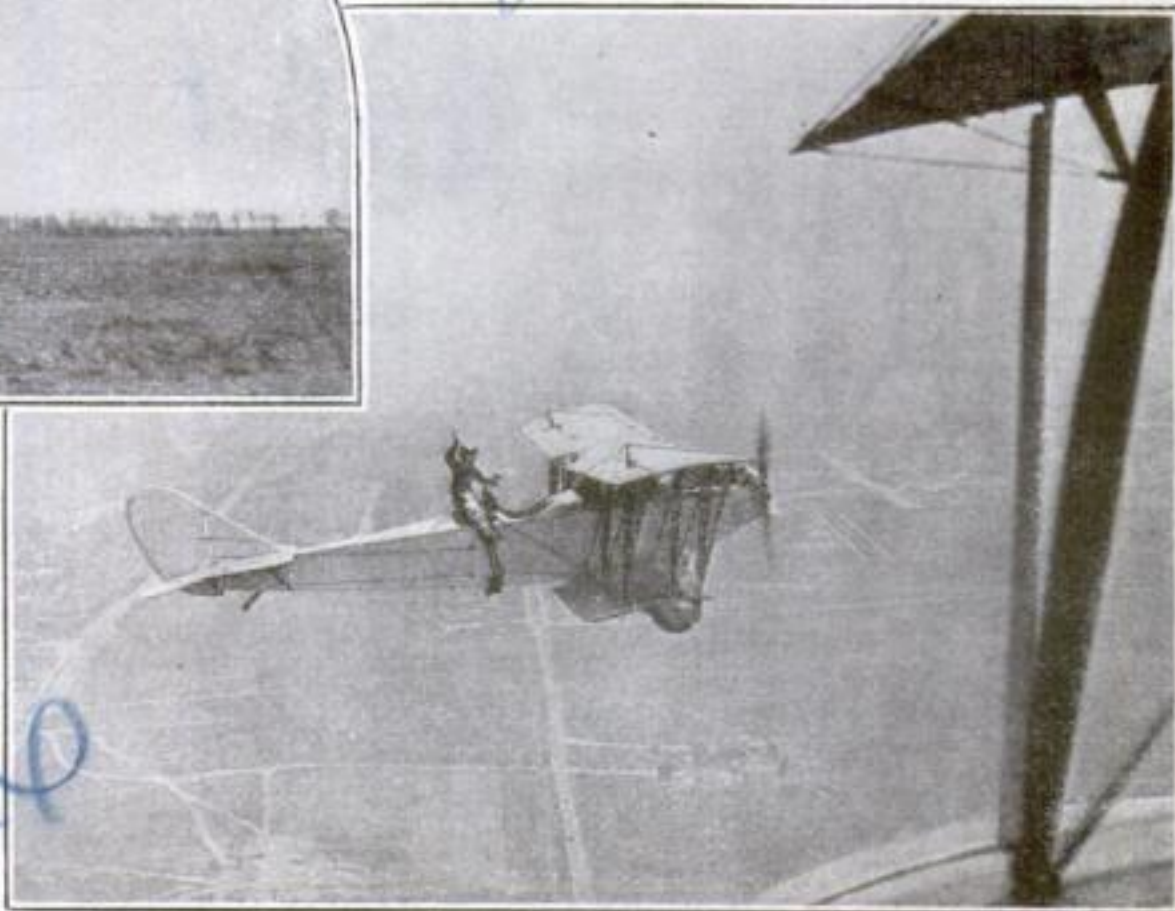


Picking Up Mail on the Fly

This picture shows how one of Germany's air-mail planes picks up a mail-bag without stopping. The bag is attached to ropes strung between two poles, and the pilot, flying low, drops an anchor that catches the ropes

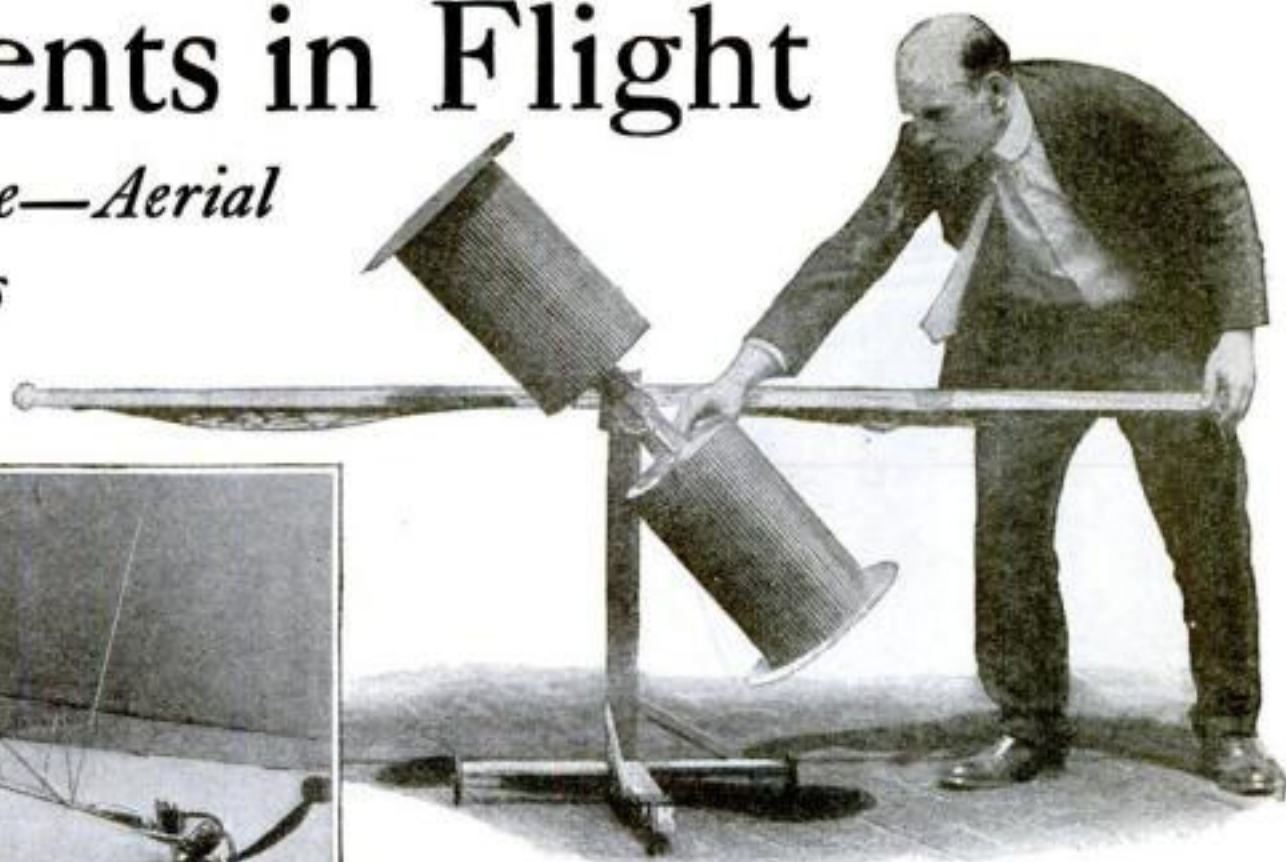
The First Aerial Cowboy

"Let 'er buck!" yelled Bob Rose when, in Los Angeles recently, he strapped his cow-pony saddle to the back of an airplane and hung on while his aerial steed twisted and turned



Achievements in Flight

A Flying Ambulance—Aerial Oddities of the Skies



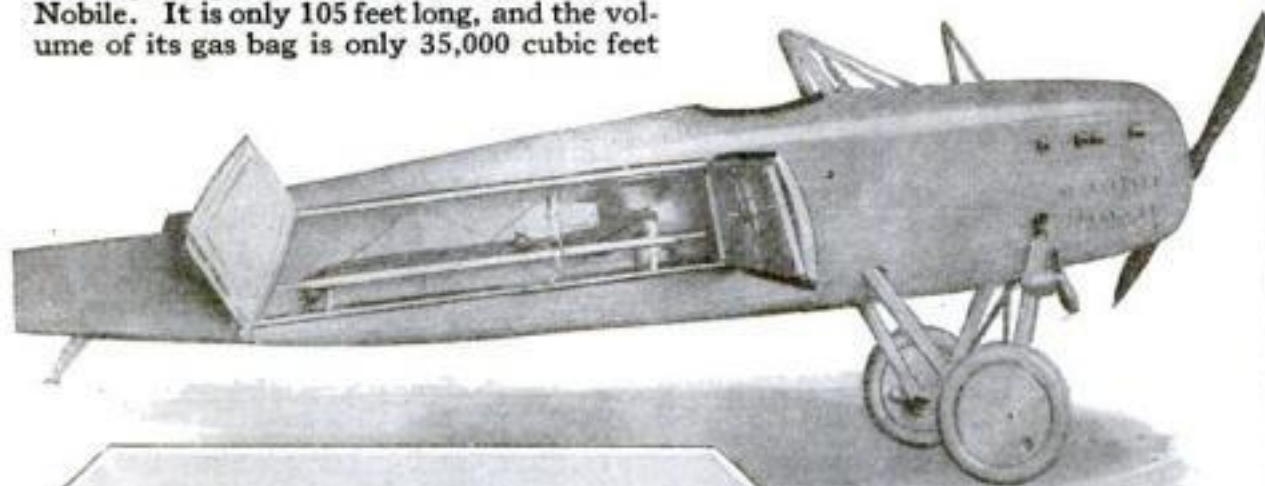
Remarkable Rotor Propeller for Airplanes

Fifty-per-cent increase in pulling power is claimed for an unusual new rotor propeller for airplanes designed on somewhat the same principle as the Flettner rotor sailing-ship



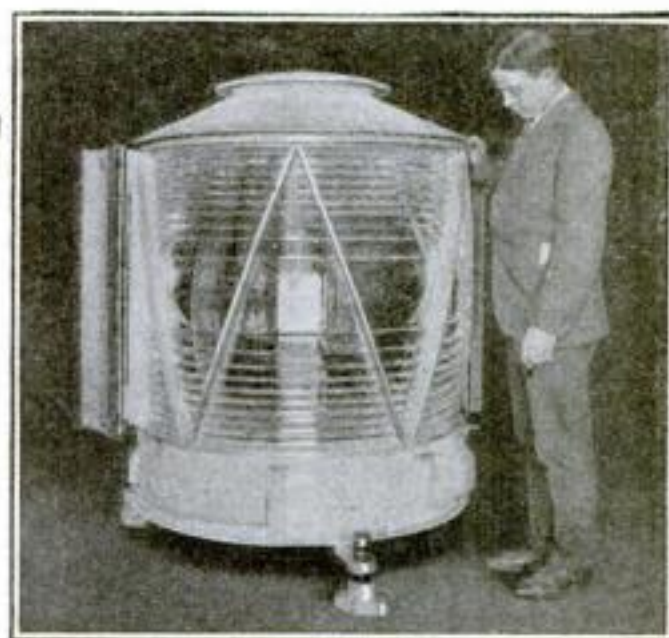
The World's Smallest Dirigible

The future of lighter-than-air "yachts" is forecast by the world's smallest dirigible, recently completed in Italy by Col. Umberto Nobile. It is only 105 feet long, and the volume of its gas bag is only 35,000 cubic feet



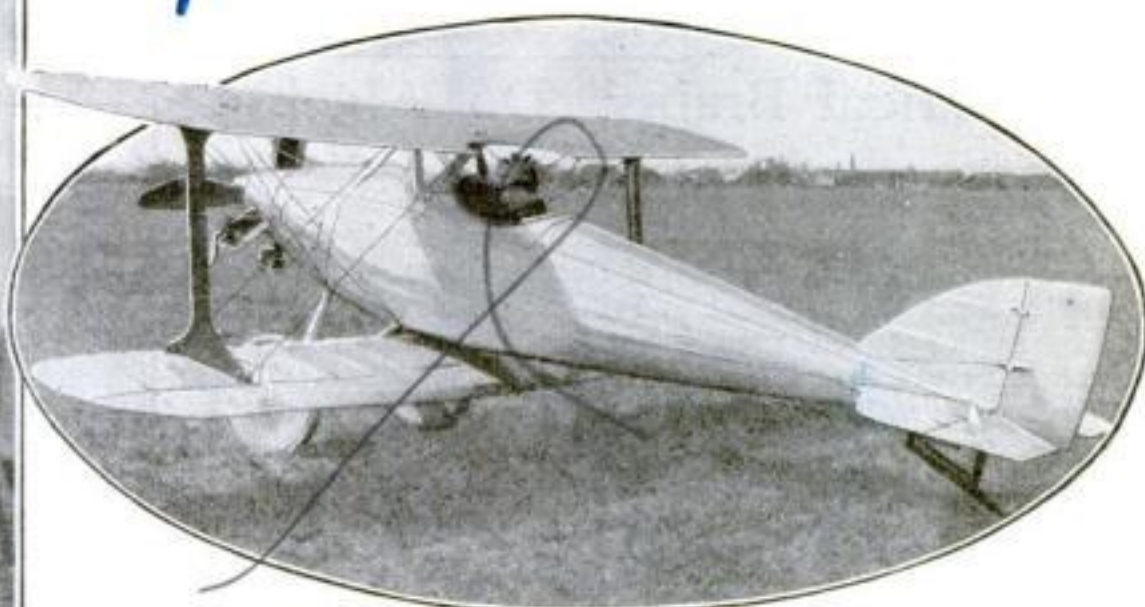
Airplane Ambulance

This novel machine, exhibited in France, has a small compartment, opening from the side, for the ambulance stretcher



Huge Flying-Field Lantern

Light radiates in all directions from this huge searchlight, imported from France for use on the air-mail landing-field at Cleveland, Ohio. It illuminates an area within a radius of three-quarters of a mile



Nobody Was Hurt

A French pilot not long ago accidentally landed on the roof of the plane's hangar near Paris; with the startling result pictured at the left

Garage-Sized Biplane

In a test at Lincoln, Neb., this baby biplane is reported to have traveled 100 miles an hour. It weighs only 350 pounds and fits in a garage

Automatic Post-Office also a Telephone Booth

AN AUTOMATIC post-office that supplies stamps, receives letters, and provides telephone service, all without the assistance of an attendant, has just been built by the British postal authorities at St. Martin's-le-Grand, London, not far from the General Post Office. It is an experimental structure intended for erection at Bath, Somerset, and other stations as a substitute for temporarily closed postal offices. If the new post-office kiosk proves a success, similar structures may be installed in busy streets as a permanent system.

The kiosk is about nine feet high and 3½ feet wide. The inside is designed as a soundproof telephone booth. The letter-box is built into the back of the kiosk and above it are the stamp machines. At night the automatic post-office is illuminated by an electric lamp and the signs, "Post-Office," "Stamps," and "Telephone," also are illuminated.



The post-office and telephone booth



Compact Curling-Iron Fits in Vanity Case

THERE always seems to be room for just one more accessory in a woman's vanity case; and so she undoubtedly will find room for one of the latest novelties—a handy little curling-iron. It will fit into a case less than 4½ inches long.

The new curling-iron is contained in a telescoping metal tube which, when extended, exposes a small spirit burner. When this burner is lighted, as shown above, the flame heats the metal of the iron, which must not be allowed to get too hot, as it is harmful for the user's hair and the iron itself.

Bacteria in Hailstones

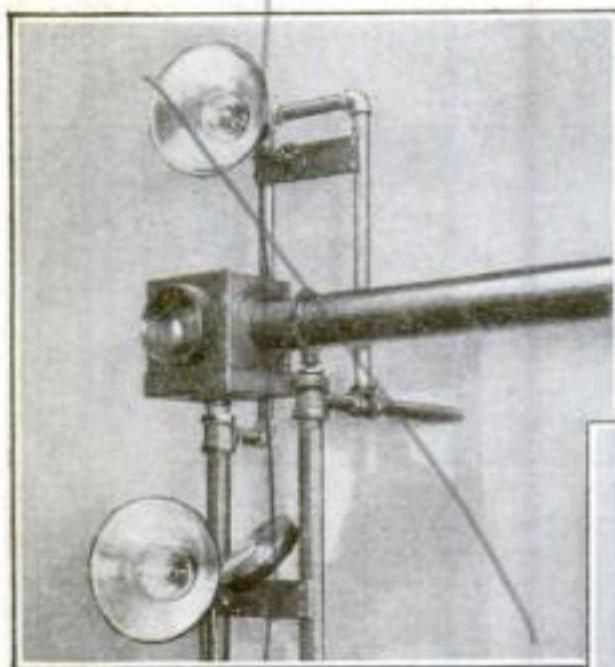
EVER since the discovery, a few years ago, that fog and rain are caused by the condensation of water vapor around nuclei consisting of small particles of mineral or organic matter that had been carried by warm air currents to great heights, R. Dubois, a noted physiologist of Lyons, France, devoted considerable study to this subject. With great care and infinite patience he collected droplets of fog and rain, crystals of snow and hailstones, and submitted them to a microscopic examination.

In most cases Mr. Dubois found that the nuclei of condensation consisted of extremely fine particles of organic or mineral matter, volcanic ash, pollen of conifers and other plants. Particularly interesting is the fact that recently he discovered that in many cases hailstones were formed by condensation of water vapor around microorganisms of a type resembling that of certain phosphorescent bacteria. Among them was found a microorganism heretofore unknown, which he named *Bacillus grandiosum*. The bacterium resembles in form that of a shoe sole and its color is a delicate red or rose.

Periscope to Protect Bank Vault from Bandits

has an outlet or peephole set in the stone facing of the building. By this means any one approaching the doors of the vault intent on robbery can be observed by an officer from the outside of the building where vault is installed.

The picture at the left shows the periscope installation in the interior of the vault, with a sighting tube that leads to the peephole on the exterior, which is shown in the illustration below.



The periscope apparatus in bank vault (left) and the peephole outlet in front or street wall of bank

AS A protection against bandits, a bank at Portland, Me., recently fitted its safety vault with a periscope through which a policeman on his rounds is enabled to view the interior of the vault from the outside of the bank building.

The periscope, consisting of an optical system of prisms and lenses, is concealed inside the vault, and

"Mechanical Brains" Do Algebra

TWO different types of "mechanical brains"—machines that perform the most complicated mathematical problems automatically—recently have been perfected separately by two young inventors, Frank P. Gage of Boston, Mass., and Stuart C. Dodd, a graduate student in Princeton University. Both are expected to prove of great importance in psychological and educational research, and in industrial statistical work.

The Gage invention has aroused keen interest among students and professors at the Massachusetts Institute of Technology, where it has been tested. The inventor claims his device has the mechanical ability to solve within an hour a mathematical problem that ordinarily takes three or four days to solve.

Dodd's invention is known as a correlation machine, designed to indicate how much one set of facts is the cause of, or is related to, another set. It solves quickly the most difficult problems of algebra. It is said to be so constructed that by its use insurance companies can determine a man's expectancy of life by comparing his physical ailments and habits with the average for other men in his class.



Frank P. Gage (left) with Herbert R. Stewart, working on machine



Draftsman's Fountain Pen Is Made Adjustable

FOR the use of draftsmen, mechanical engineers, and professional men, a new fountain drawing-pen has been devised. As with the ordinary drawing-pen, it can be regulated to give any stroke, from a hair line to a bold line, and as it works on the same principle as the fountain pen, it can be carried conveniently in the pocket.

Derelict Ship Wanders Seas for More than Two Years

DRIFTING about on the Atlantic Ocean, the dread of hundreds of skippers, is a ship like the *Flying Dutchman*, without crew or sails. For nearly two years she has been wandering without guidance. A. B. McManus, of the Hydrographic Office of the U. S. Navy, believes that she now is headed toward the Sargasso Sea.

The ship sailed in September, 1923, from Nova Scotia for Brazil, with a cargo of lumber. A severe storm came, damaging her severely. The crew was rescued and the ship abandoned.

The lumber cargo keeps her afloat. Once she was reported on fire by a vessel that sighted her, but when seen again the fire was out. Once a coastguard cutter took her in tow, but struck a gale and she was again a wanderer.

No one knows where the derelict is now, which makes her very dangerous to others.

A BRONZE tablet has been placed in Menlo Park, N. J., on the spot where Thomas Edison perfected the electric light, the phonograph, and the motion-picture machine. The inscription reads, "On this site 1876-1882 Thomas Edison began his work for service for the world to illuminate the path of progress and lighten the labor of mankind."

Dispensing Machine Makes Paper Drinking-Cups

YOU manufacture your own paper cup as you turn the crank of a new dispensing machine, pictured at the right. In the same operation the completed cup drops into a receptacle, ready for use. America uses forty million paper cups a day, and this recent invention was designed to cut down the cost of making them.

A roll of white paper fits in the machine. A simple mechanism shapes the cup and makes it water-tight without the use of paste or glue.

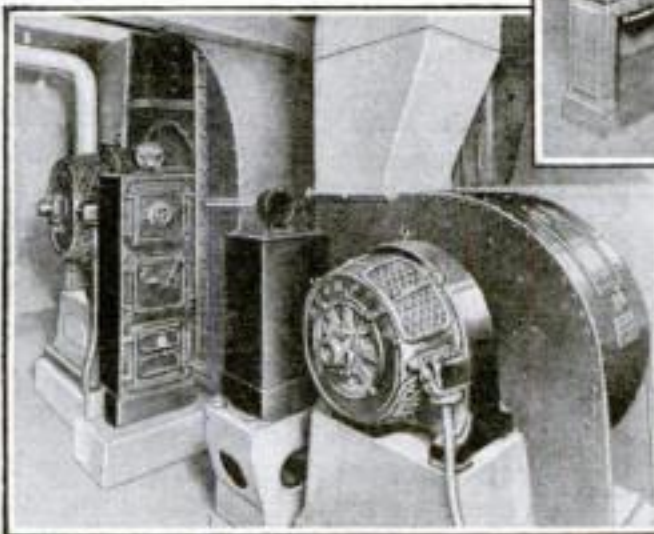
EUROPE has a real skyscraper. It is in Cologne, Germany, and towers all of nineteen stories high. While Europeans say that it is an American model, American travelers deny the resemblance. It is of heavy red brick, with no ornamentation and is said to look like some medieval castle rather than like one of our own efficient looking office buildings.



Pressing a lever forms cup

Fresh Air for Every London Councilman

AN UNUSUAL system of air ventilation installed in the London County Council Hall in London, England, makes it possible for each member of the Council to control, independently from his desk, the condition of the air immediately surrounding him. This is accomplished by an arrangement of supply and extraction openings,



Machinery for conditioning the air. Above: View of council hall, showing individual ventilators

placed so that by manipulation of a lever beneath the desk the occupant can direct the flow of air upon himself or upward into the general atmosphere. Thus the air of the chamber constantly is being removed and renewed. The entering air is heated and humidified in the winter; cooled and dehumidified in the summer. The apparatus for washing and conditioning the air is situated under the Council Chamber.

Light Bulbs without Filaments

THROUGH the invention of an electric-light bulb that requires no filament, Conrad Schickerling, of Newark, N. J., claims that municipal lighting bills may be cut in half. A 500-watt lamp of the new type, he says, will burn twice as long as filament lamps and consume less than half the current now required.

The inventor also has made lamps of two-watt size for use on signs. These, he declares, will reduce the cost of current to 20 per cent of its present level. Auto lamps of two candlepower and higher, without filaments, also have been tested. An advantage claimed for these is that jarring will not injure nor break them.

Still another invention of Schickerling is a vacuum tube without filament or grid, designed especially for alternating-current rectification in radio B-battery eliminators. He claims the tubes produce perfect rectification, devoid of all alternating-current hum and noises.

In the photograph the inventor is seen holding in his hand one of the new radio tubes. On the table are a large electric-light-bulb of 500 watts and a smaller one for use on signs.



Conrad Schickerling, with three types of his filamentless bulbs

How to Construct a Compact

*An Ideal Portable Unit
for Summer Weighs
But Three Pounds*

By Alfred P. Lane

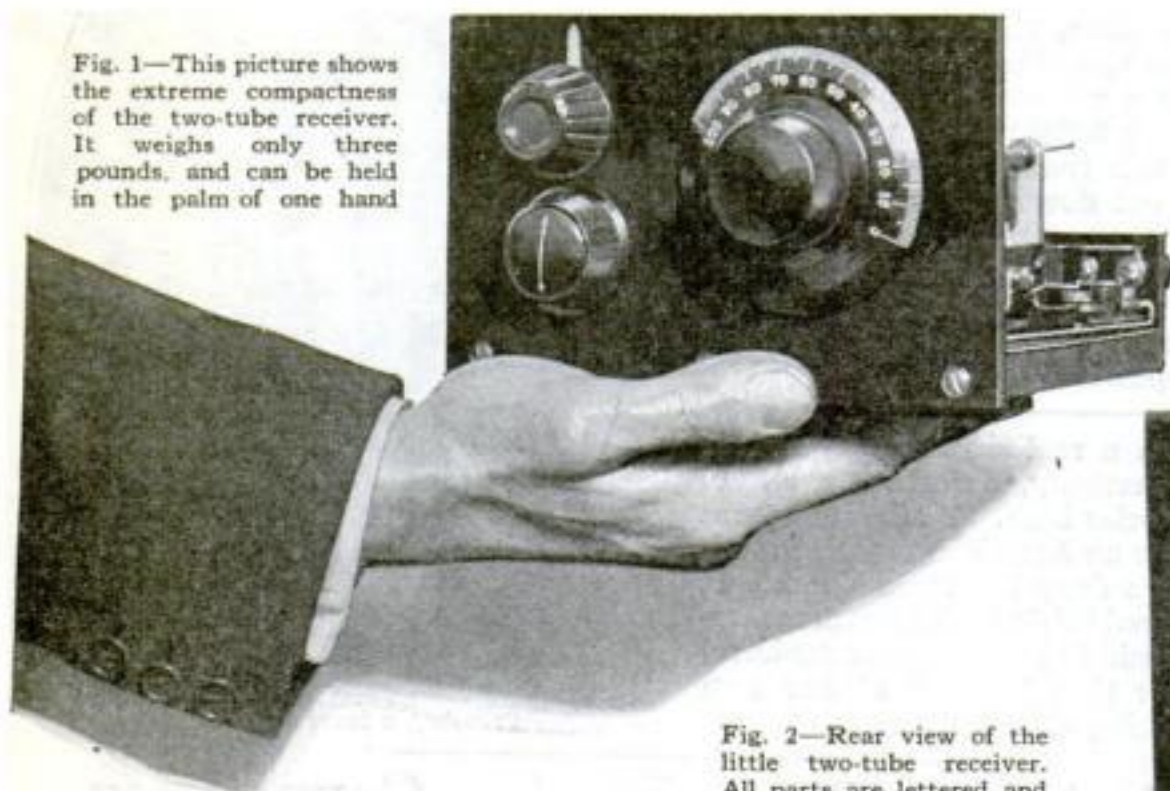


Fig. 1—This picture shows the extreme compactness of the two-tube receiver. It weighs only three pounds, and can be held in the palm of one hand

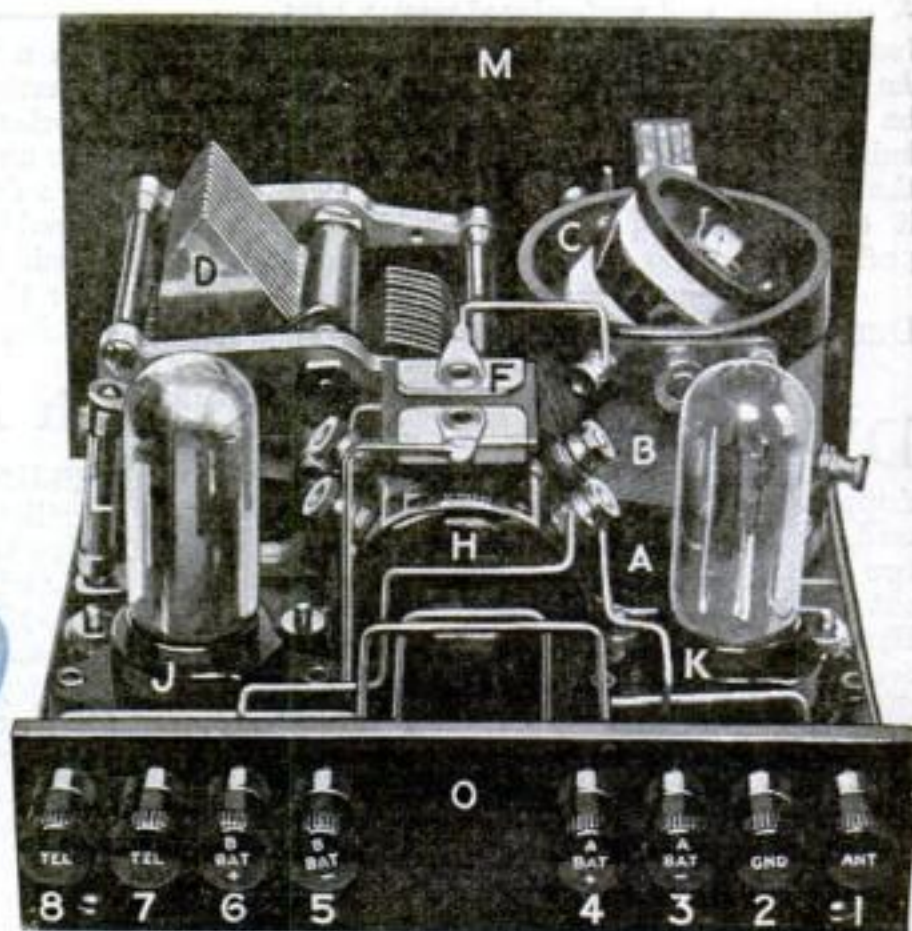


Fig. 2—Rear view of the little two-tube receiver. All parts are lettered and numbered to correspond with the list of parts to be found on the opposite page

THE word "portable" as applied to radio receiving sets seems to have many meanings. At one end of the scale we have portable radio sets that are moved around about as easily as a heavily loaded trunk. At the other we have sets built around toothbrushes, inside thimbles, and similar queer containers.

The two-tube receiver described here approaches neither extreme. It is simply a good two-tube unit built of standard parts and made as compact as possible.

Every radio fan has his own ideas as to how to make up a portable outfit, and so several sketches are shown on these pages that will help you to decide on an arrangement best suited to your own particular needs.

The set operates with two three-volt dry-cell vacuum tubes and a plate voltage of 45. It is possible, therefore, to run the set using two standard C batteries in parallel for the A-battery supply, and two

of the small B batteries in series for the plate current. The receiver itself as shown in the illustrations weighs just a shade over three pounds, so a complete outfit consisting of a light case, batteries, head phones, and wire for antenna should not prove a burden. Of course, for regular use at home you naturally will prefer to use the large size A and B dry cells because they are much more economical.

The circuit is, in many respects, similar to that used in the one-tube receiver described in the May number of POPULAR SCIENCE MONTHLY. The main difference is that the tickler coil C in this month's receiver is movable instead of fixed, and a fixed condenser is used instead of the variable one shown in the May set. This change does not affect the quality of reproduction, however.

The receiver has been tested and approved by the Popular Science Institute of Standards. Tests in the Institute Radio Laboratory show that it gives exceptional selectivity, distance, and quality. In fact, the results show that, in spite of its small size, it gives as fine radio reception as can be expected from two tubes.

Connected with a 50- to 100-foot antenna hung from any convenient tree, and a ground wire thrown into a near-by brook or lake, this portable outfit will bring in distant stations with excellent volume on the head phones.

The conventional shape of the receiver also makes it useful for regular use at home in cases where it is desired to keep the amount of space occupied by the radio equipment down to the minimum. There is no stan-

dard size of radio cabinet small enough to fit this receiver, however, so if you want to install the unit in a conventional type of cabinet, you will have to build the cabinet yourself. If you do not want to go to the trouble of building a complete cabinet, a simple dust cover out of cigar-box wood will be satisfactory.

THERE is just one point about the construction of this receiver unit that may cause the beginner some slight trouble, and that is the difficulty of making the connections between the various instruments because of the lack of space in which to work. If you have any doubt about your ability in this respect, the remedy is to spread out the instruments a bit by making the panel and base board each an inch longer.

The parts you will need to build the receiver are listed at the top of the opposite page.

In selecting the parts for your receiver, the size of each part must be carefully considered.

The tuning unit A, B, C is a standard small-sized three-circuit tuner. For the benefit of those who prefer to build this part of the receiver, the primary coil A consists of 9 turns of wire, the secondary coil B is wound with 53 turns, and the tickler coil C has 16 turns on each side of the shaft, making a total of 32 turns. The form on which coils A and B are wound is 2½ inches in diameter, and the tickler coil form is 1½ inches in diameter.

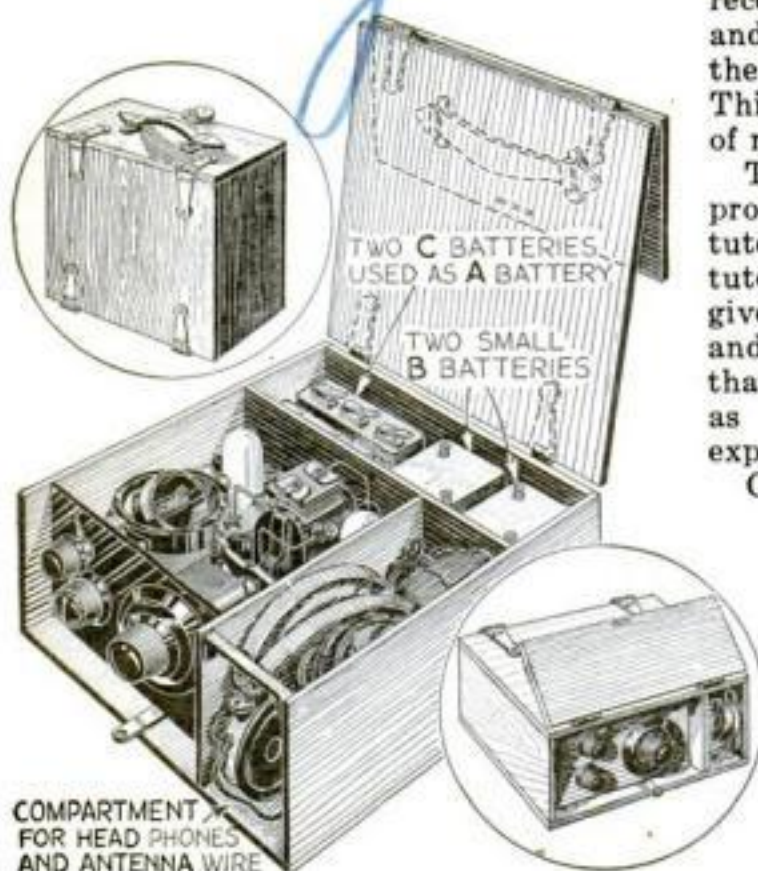


Fig. 3—Here is a suggested method of fitting the set into a portable case. This idea can be modified easily to suit your own particular needs

Two-Tube Set

The Parts You'll Need

HERE are the parts you will need for the two-tube portable unit:

A, B, and C—tuning unit
D—variable condenser, .0005 mfd.

E—grid condenser, .00025 mfd., with grid-leak clips

F—fixed condenser, .0005 mfd.

G—rheostat

H—audio transformer, 5 to 1 ratio

J and K—vacuum-tube sockets

L—grid leak, 5 to 7 megohms

M—composition panel, 4¼ by 7 inches

N—wooden baseboard, 6 by 6½ inches

O—composition binding-post panel, 1¾ by 6½ inches

Eight binding posts, three-inch dial, bus wire, tubes, batteries, etc.

Number 24 double silk-covered wire will do very nicely.

Any standard type of variable condenser can be used at D if it is small enough to fit into the space limitations.

THE vacuum-tube sockets J and K in the model receiver are adapted to the 3-volt dry-cell type tube, but there is sufficient room to permit the use of standard storage-battery tubes if you desire, and this change would be a desirable one for the man who is going to use the set on an auto-camping trip, since the storage battery on the car is handy for use as an A battery. Some form of spring-base or cushion-type socket is worth while, of course.

The rheostat G of the model receiver has a resistance of 25 ohms. If you use 6-volt storage-type tubes or 1½ volt dry-cell tubes, the rheostat should have a resistance of 10 or 6 ohms respectively.

Because of the space limitations, the building and wiring of this receiver requires more care and time than a similar receiver of standard size. This means that you will have to study carefully the placing of each wire so that it will not interfere with other wires.

The laying out and drilling of the panel

is the first operation and in this you will be aided by the diagram in Fig. 8 on page 118. But before you start drilling any holes, make sure that the instruments you have purchased will fit. If, for instance, the variable condenser D or the rheostat G are larger or of a different shape than the ones used in the model receiver, you may find it necessary to use a slightly longer or higher panel to keep the instruments from touching each other.

After you have cut the panel to the proper size and drilled the holes for the shafts of the variable condenser D, the rheostat G and the tuning unit A, B, C, together with the screw holes to hold the panel to the baseboard, you can proceed to mount these instruments and then attach the panel to the baseboard.

Next mount the audio transformer H and the sockets J and K on the baseboard. The primary terminals of the audio transformer H should be toward the binding-

post panel and the grid terminals of the sockets should be near the front panel and at the left (as seen from the rear) if you use the 3-volt dry-cell tube sockets. Study Figs. 1, 2, 4, and 6 carefully before mounting the instruments.

It is a good idea to leave the binding-post panel off until some of the wiring connections have been made. If you use the ordinary screw-type binding posts, it will be advisable to hold the panel in place while each wire is bent into shape. Then, when you have the wires ready, you can clamp down the binding posts on the binding-post panel and put in the screws that hold the binding-post panel.

WHEN you are satisfied that the instruments are mounted correctly, you can proceed with the wiring as follows:

Connect the filament terminals of sockets J and K, which are nearest the front panel, and run a branch from this wire down between transformer H and socket K and over to binding post No. 4. Continue this wire over to binding post No. 2. Next, run a wire from the F terminal of transformer H down to binding post No. 3 and continue it around to one terminal

(Continued on page 118)

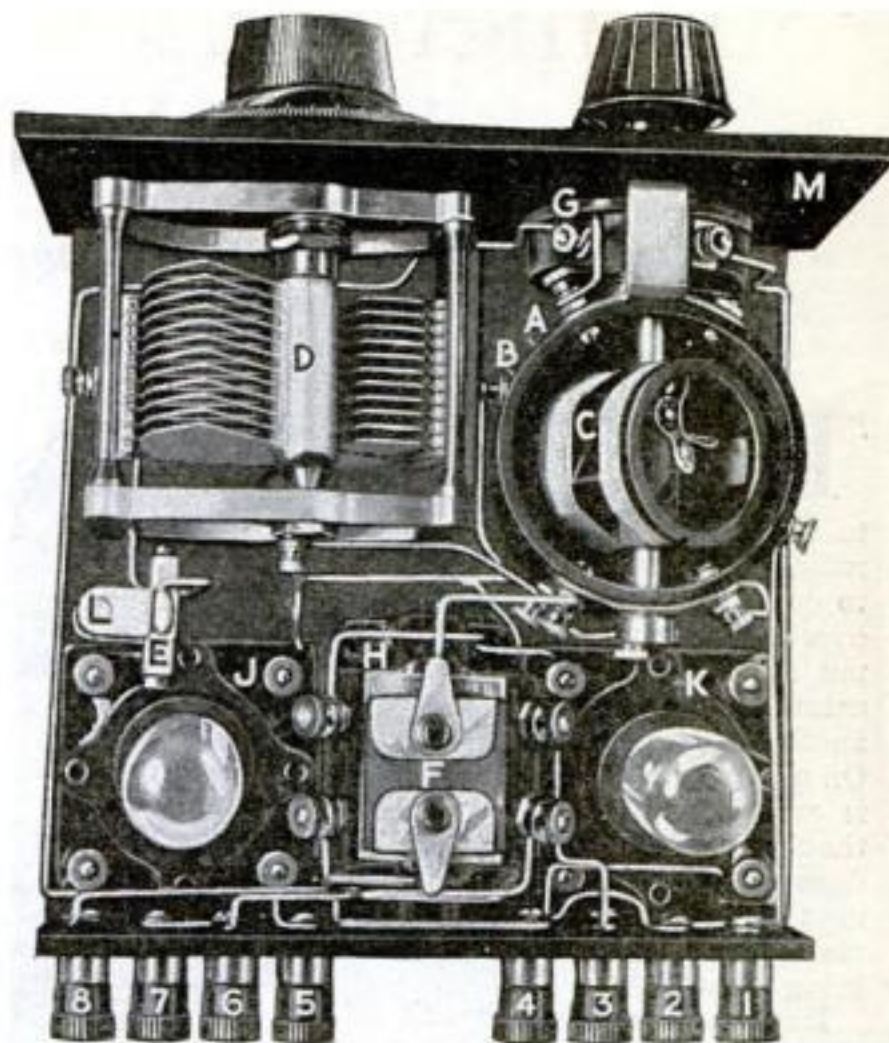


Fig. 4—View of the set from above. Notice how ingeniously the instruments are arranged to conserve space

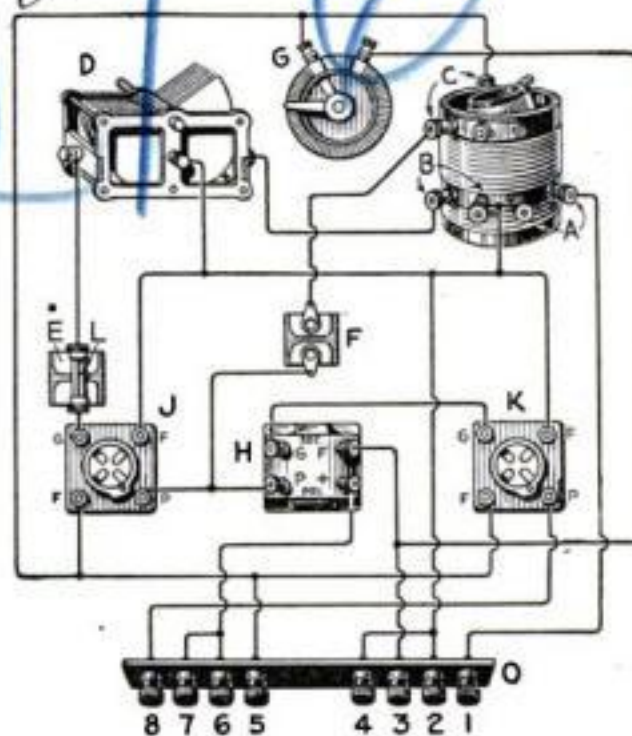


Fig. 5—Pictorial wiring diagram for beginners who are unfamiliar with the symbols

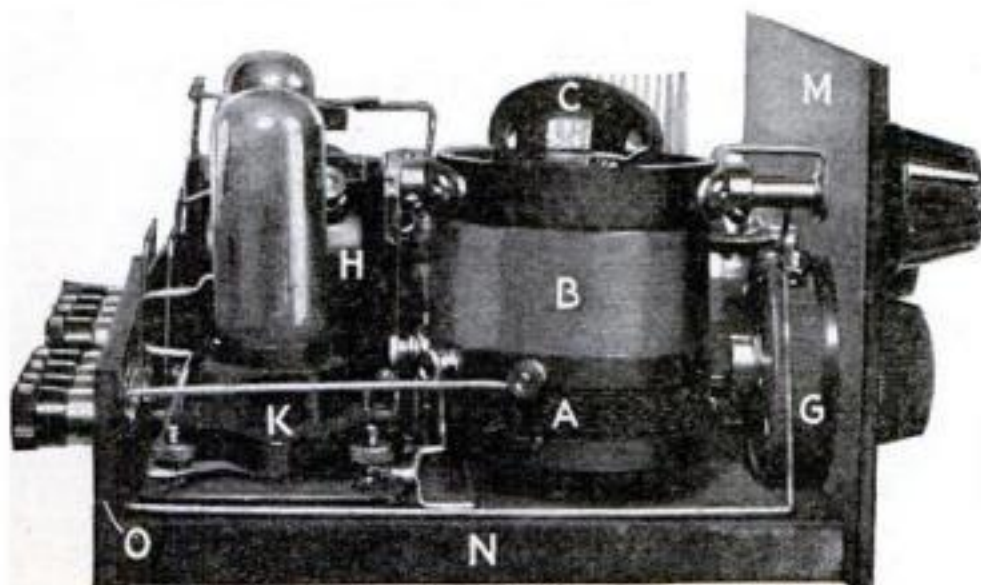


Fig. 6—Side view showing the hook-up of the tuning coil

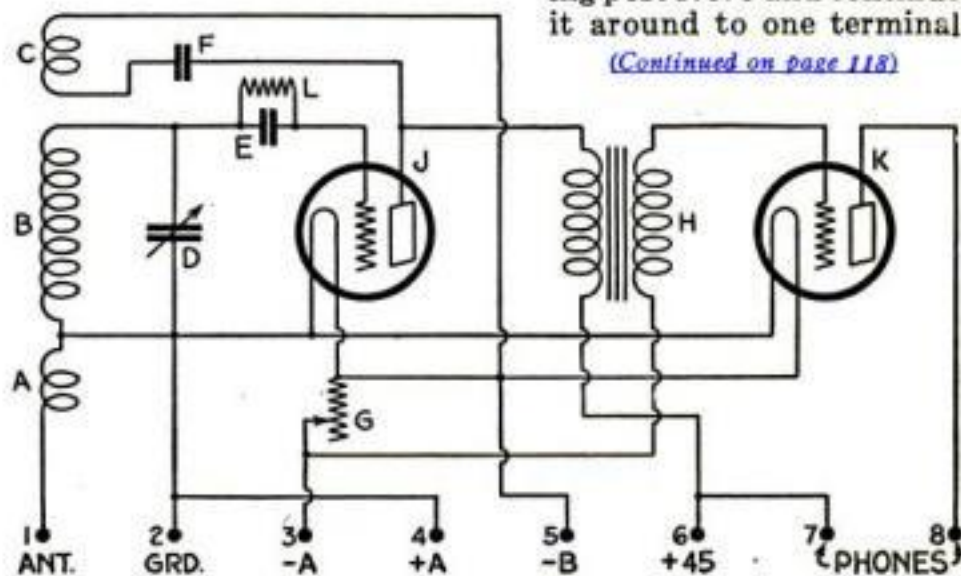


Fig. 7—Wiring diagram with parts represented by radio symbols

Summer's the Time to Overhaul Your Set

How to Prepare for Good Reception

By E. R. Haas

THE coming of summer affords us all a chance to take stock of our radio equipment and to do the necessary overhauling that will put our apparatus in extra good shape for another season's use. On nights when static is exceptionally bad, the overhauling can be done without the feeling that some important broadcasting is being missed.

Haphazard digging around in the receiver with a screwdriver is not the right way to go about a systematic overhauling. To begin with, you should make a list of the things that ought to be looked into, such as the list on this page, and then you can place a check mark against each item as soon as you have attended to it.

Since it is logical to start at the top, we can begin with the antenna.

What is needed to put your antenna system in good condition will depend on how good a job you did in the first place and on how long it has been in place without attention. If you used a plain copper wire and the antenna has been up for more than six months, the chances are that the copper has corroded so that the surface is no longer smooth and shiny. The rough surface offers some resistance to the passage of high-frequency current. You can, of course, polish the surface of the wire with fine sandpaper, but you will find it much more satisfactory to renew the antenna completely with enameled copper wire. The enamel coating stays on the wire for years and protects the surface of the copper from corrosion.

THE insulators should be wiped carefully to remove grime that collects on them and acts as a high-resistance leakage path for the minute electrical currents in the antenna circuit.

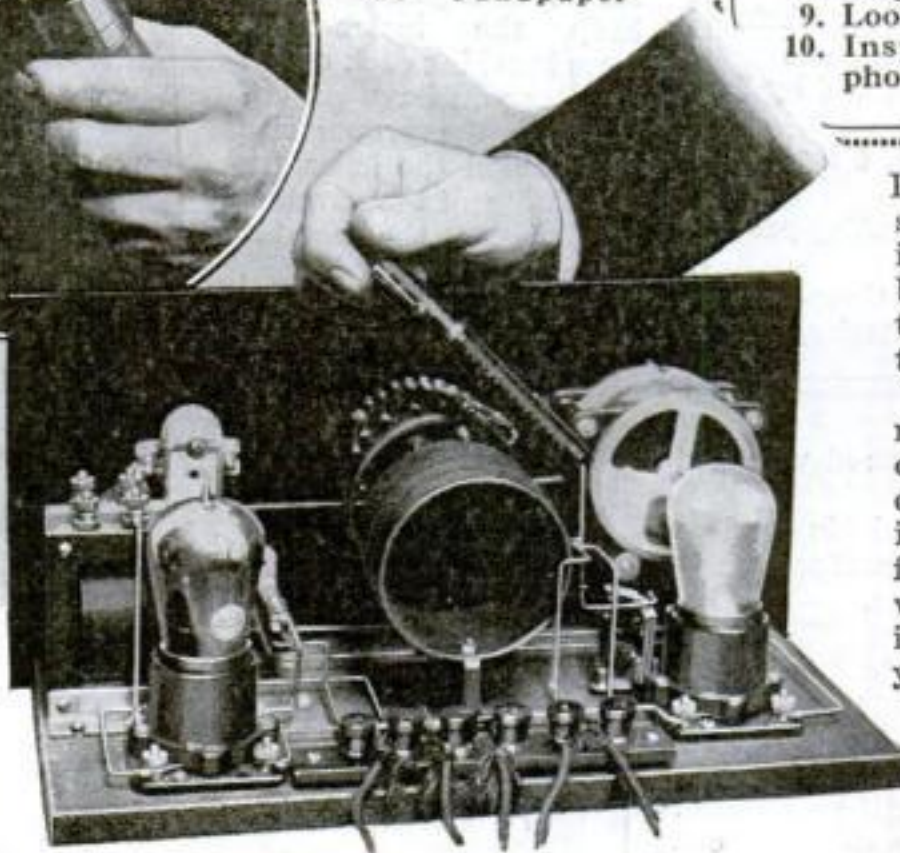
You can't be too careful to support the antenna rigidly, for the weight of a long antenna covered with a thick layer of sleet is considerable.

The connection between the lead-in and the antenna should receive careful attention. Corrosion at this point will cause weak signals and may result in noisy reception. A carefully soldered joint where the solder actually has flowed on the surface of both the antenna and the lead-in wires, will not give much trouble, but if the wires merely are twisted together without soldering, it is a good plan to cut the lead-in, scrape another clean place on the antenna, and twist a new joint. If



For Good Contacts

To assure good contact between the tube prongs and springs in the socket, clean the tips of the prongs with a piece of sandpaper



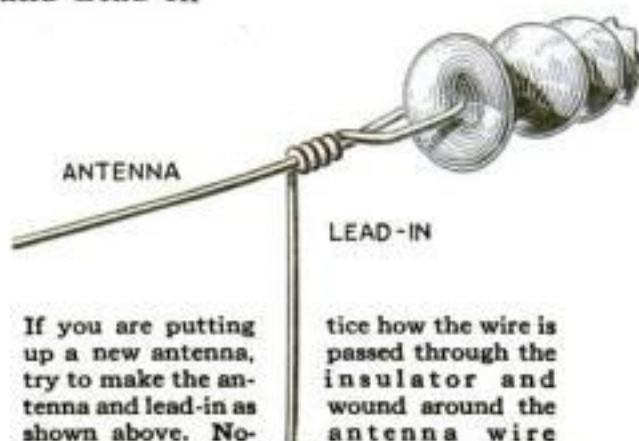
How to Locate Loose Connections

Disconnect antenna and ground, then, with tubes lit and B battery and loudspeaker connected, push each wire in turn with the cap end of a fountain pen. Scratching or clicking noises indicate a loose wire that must be found

you are putting up a new antenna, try to make the antenna and lead-in a continuous piece of wire. The illustration at the bottom of this page shows how to do it.

The next task is to test all the connections within the receiver itself. The easiest way to do this is to disconnect the antenna and ground; then, while the tubes are lit and the B battery and loudspeaker connected, push against each wire in the receiver with the end of a wooden stick or the end of a hard rubber fountain pen. Also press against the tubes themselves.

Continuous Antenna and Lead-In



If you are putting up a new antenna, try to make the antenna and lead-in as shown above. No-

tice how the wire is passed through the insulator and wound around the antenna wire

Check These 10 Points

1. Clean insulators and renew antenna with enameled copper wire.
2. See that antenna supports are strong enough to withstand winter storms.
3. Inspect connection between antenna lead-in and antenna.
4. Tighten loose binding posts.
5. Test all connections.
6. Make sure that contact prongs in tube sockets are making good contact with tube terminals.
7. Clean thoroughly the interior of your receiver.
8. Inspect ground connection.
9. Look over A and B batteries.
10. Inspect flexible cords of phones and loudspeaker.

If this procedure results in scratching or clicking noises in the loudspeaker, you may be sure that the wire being tested is loose at one end or the other.

In making this test, remember, however, that the contact between the prongs of the tube and the springs in the socket is rarely so perfect that no noise whatever will be heard when the tube is touched. To be sure that you are getting the best contact possible, it is a good idea to bend up the springs in the sockets a bit and clean the prongs of the tubes with a piece of sandpaper.

After you have made sure of good connections, clean the inside of the receiver thoroughly. This means dusting off every part as carefully as possible, not forgetting to run a pipe-cleaner between the plates of the variable condensers.

The ground connection, because it is indoors, is not subject to corrosion as is that between the antenna and the lead-in. If you made a good ground connection when you first installed the receiver, you can be reasonably sure that it is still in perfect condition.

DRY-CELL A and B batteries require no special attention other than to see that all connections are tight. With storage batteries, however, it is a good idea to clean off the tops and terminals with a rag moistened with ammonia and then grease the terminals with vaseline.

Your storage A battery may have been on the job for several years and you now are beginning to wonder whether it still is good for another year's service. There are two almost infallible indications of deterioration. One is the failure of the battery to hold its charge while standing idle. This usually means worn-out separators. The other is the failure of the hydrometer reading to go above 1250, regardless of how long the battery is left on charge. A low hydrometer reading when the battery is as completely charged

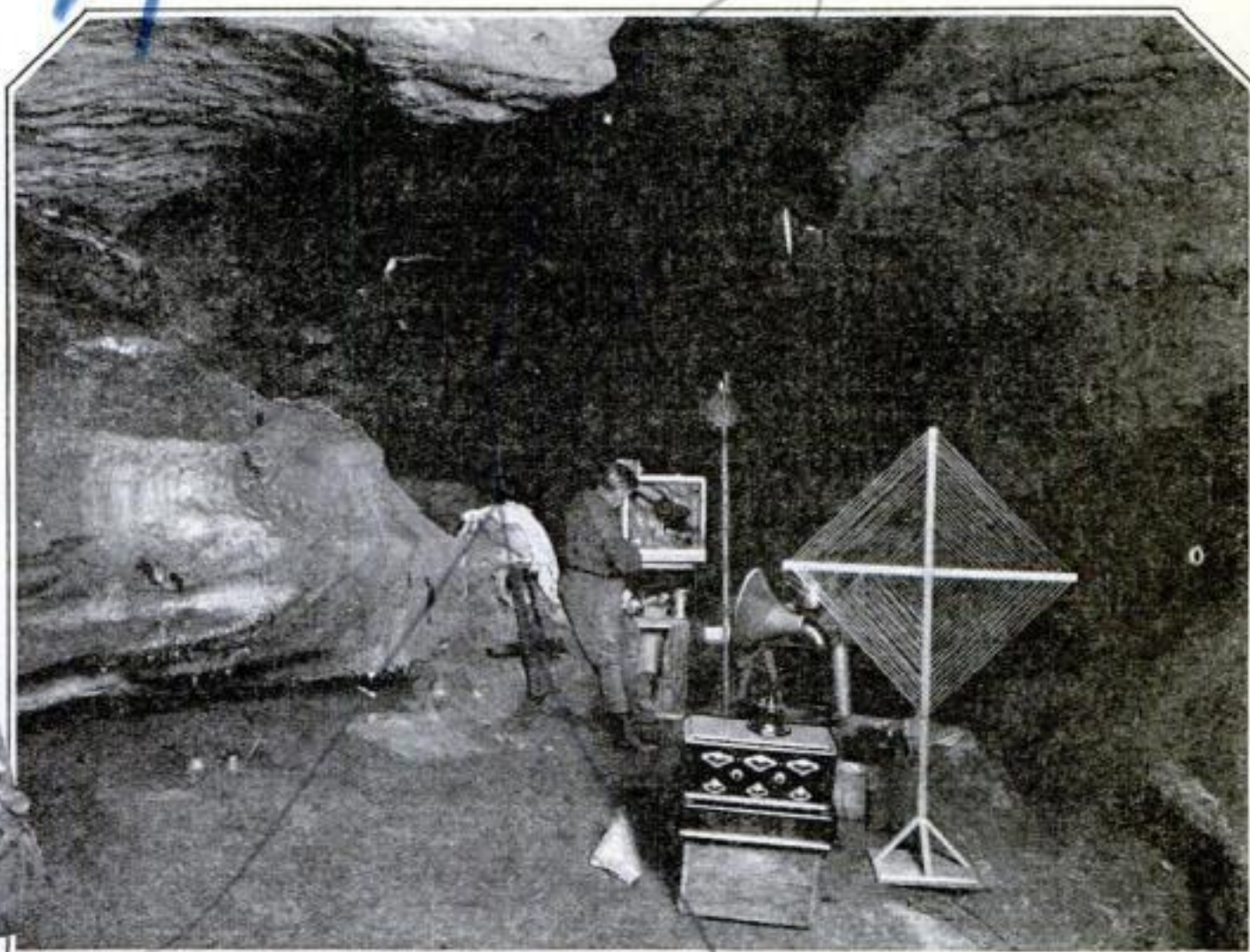
(Continued on page 119)

Latest Novelties of Broadcasting

Radio in a Cave and on a Motor-Boat—New Inventions

New Power Tube

Professor Holweck of Paris has just perfected a new demountable vacuum tube (below) rated at 100 kilowatts. Instead of pumping all the air from the tube and then sealing it, the inventor mounts it on a remarkably efficient vacuum pump that is kept running while the tube is in full operation.



Radio in a Cave

Working 300 feet underground, Mr. Fortous, of the Milwaukee Public Museum, found that radio relieved the tedium of his work in making a model of a Virginia cave.



Broadcasts Races

Station WJZ, New York, recently gave a vivid account of a college boat race by rebroadcasting signals from a motor-boat (below) equipped especially for low-wave transmission.

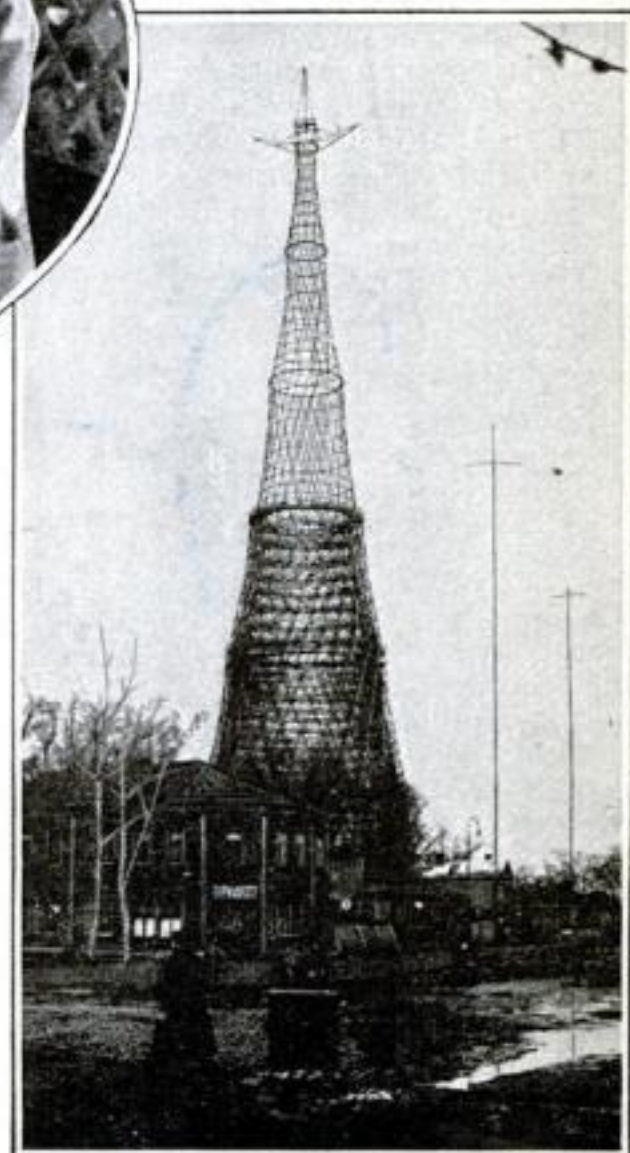


New Loudspeaker

E. W. Kellogg and Chester W. Rice are shown above examining a hornless loudspeaker they have perfected. It operates on the electrodynamic principle and uses a paper cone about six inches in diameter.

Skeleton Mast

The mast of a new radio station in Moscow, Russia (right), is built in an extended basket-weave fashion. It is claimed that the structure is very rigid in the wind.



Tests by Popular Science Institute of Standards Reveal Surprising Facts about Tuning Coils

By Thomas Vanacore

IN ADDITION to our regular test work in the Radio Laboratory of the Popular Science Institute of Standards, we are constantly carrying on research work along various lines and occasionally the results obtained play havoc with some of the accepted ideas on good radio construction.

Take the matter of radio tuning coils, for instance. Every radio fan who builds sets, and nearly every buyer of a factory-built receiver, has ideas as to what constitutes a good tuning coil. Some prefer cotton-covered wire. Others insist on silk. Many persons also are prejudiced in favor of various kinds of basket-weave coils.

A series of tests covering every conceivable kind of radio tuning coil would, of course, be far too long to describe here, but the results of a careful series of tests on plain cylindrical coils just completed in the Institute's Radio Laboratory, are so amazing that we feel sure every reader of POPULAR SCIENCE MONTHLY who is interested in radio will want to know about them.

To begin with, we wanted to find out what advantage, if any, there was in silk-covered wire compared with cotton-covered and enamel-insulated wire, since these three kinds of wire are most in use.

Also, we wanted to settle the question as to what effect moisture has on coils. This is highly important because a great deal of the poor reception in summer is often blamed on moisture in the coils.

TO MAKE the test a fair one, we used just one size of wire and one size of composition tubing. We first wound three coils, of 44 turns each, using the three kinds of wire. The lengths of the windings of the different coils were as follows:

No. 22 d. c. c. 1 9/16 inches
No. 22 d. s. c. 1 1/4 inches
No. 22 enamel 1 1/8 inches

To cover the broadcasting wave-length range most effectively with a tuning condenser having a maximum capacity of .0005 mfd. we found that the number of turns required are:

Cotton 48 turns
Silk 45 turns
Enamel 44 turns

These measurements are particularly interesting to the home



Making the Moisture Test

Here is part of the apparatus used in the Radio Laboratory of the Popular Science Institute of Standards to test the effect of moisture on tuning coils. Three coils were hung for three hours in a cabinet containing a pot of boiling water on an electric stove

set-builder if he wants to wind coils with insulation other than that specified in the instructions for constructing the set he is working on. They enable him to determine accurately the proper number of turns needed with any one of the three kinds of wire when three-inch tubing is used.

So much for the matter of wave lengths and actual constructional data. Now we come to the results of our tests.

We found that cotton-covered wire

under these particular conditions is better for radio use than either silk covered wire or enameled wire.

The chart on this page, showing the comparative resistances for the various kinds of wire, tells the story in graphic form. Of course, the difference is not great and, in fact, it is doubtful if any appreciable difference could be noticed in signal strength under actual working conditions. Nevertheless, the fact remains that cotton is just a bit better than silk.

WHAT effect has moisture in the air on the efficiency of radio coils?

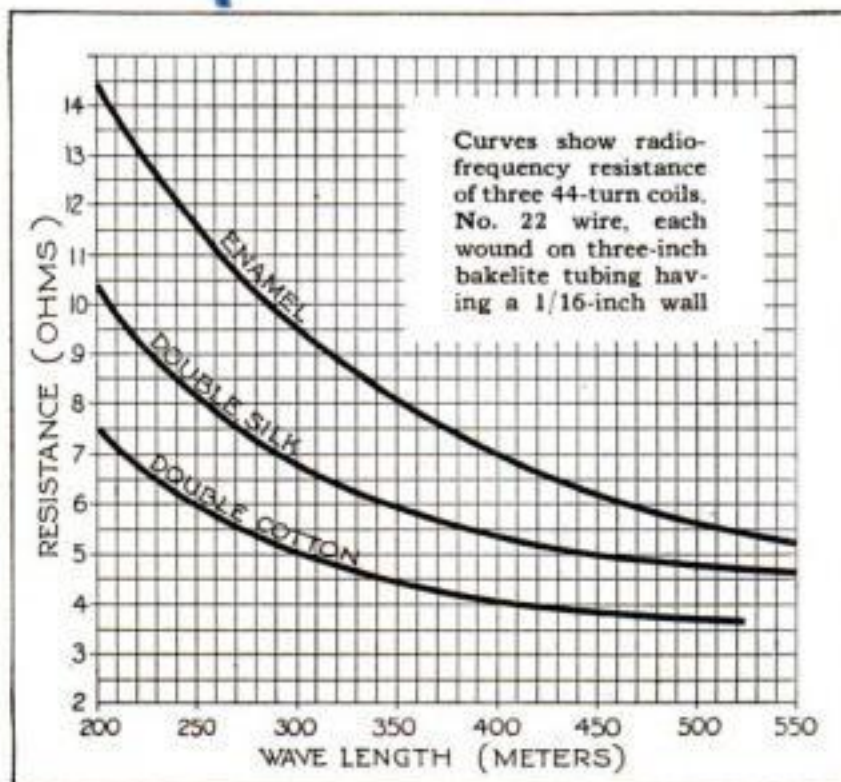
We hung all three coils in a metal box containing an electric stove under a pot of water as shown in the illustration. The current was turned on, the box closed and left for three hours. On opening it we found the water nearly all boiled away, water was running down the metal sides of the box and the air in the box was as damp as the air in the tropics after a severe rainstorm. We hustled the coils over to the test bench and repeated our resistance tests. There was no change—the meters read exactly the same!

We could hardly believe the result ourselves, it seemed so at variance with all of the theories on the subject. To leave no room for doubt, we took the coil wound with cotton-covered wire and deliberately put it in a pail of water and left it there for several minutes. Then we took that coil, with the water actually dripping from it, and put it back in the test circuit.

THERE was no doubt about the resistance under these conditions. It was nearly seven times normal, but the startling fact that confronted us was that within a few minutes, even while the water was still dripping from the coil, the meter readings began to go up and before the coil felt dry to the touch the resistance had returned to normal.

Think of it! Here was a coil so wet that you could feel the dampness in it, and still it was apparently perfectly good for radio use. These tests would seem to indicate that, short of deliberately allowing rain to fall in a radio set, or pouring a bucket of water over the apparatus, moisture can have little or no effect on reception.

(Continued on page 117)



Comparative Efficiency of Coil Wires

This chart, showing the comparative resistances (in ohms) of three types of insulated wire at varying wave lengths, indicates that cotton-covered wire is the most efficient for radio coils

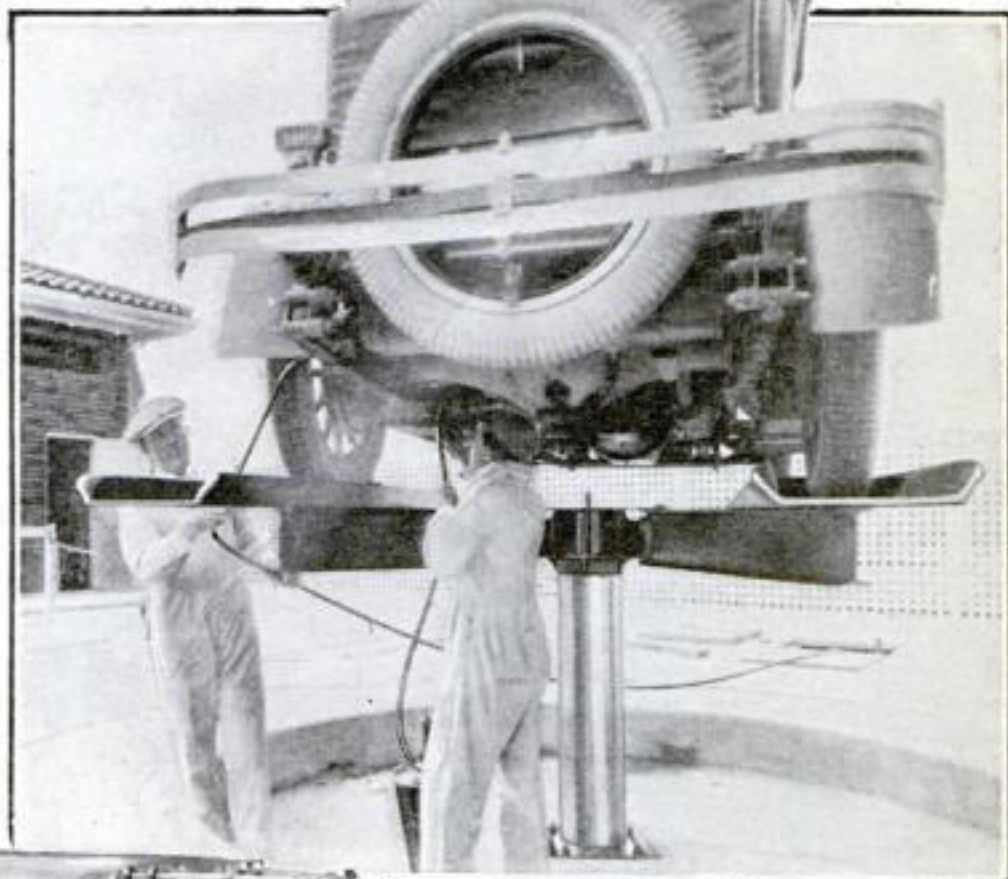
Useful Ideas to Aid the Motorist

Dog's Coupé an Amusing Novelty



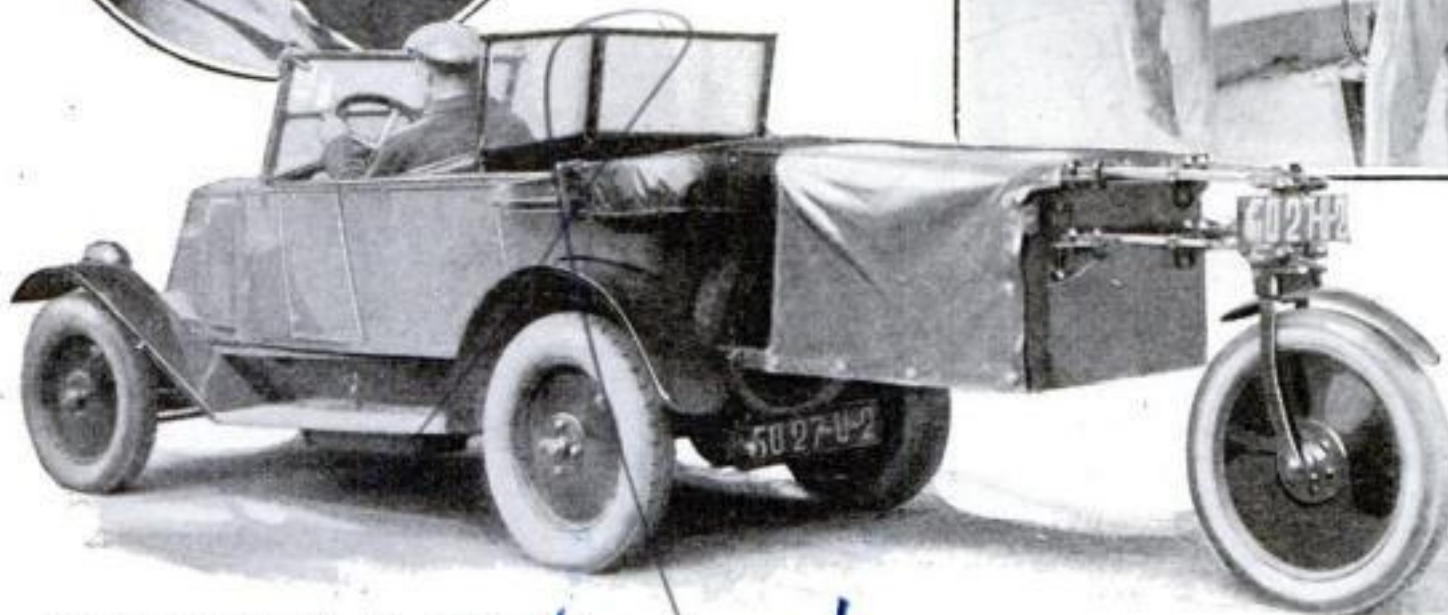
Face Windshield

Here is a novel English idea for protecting the motorist's face. The curved screen is made of clear celluloid and is pivoted on two press buttons fixed to the side of the cap so that it can be swung out of the way.



Hydraulic Auto Lift

Non-freezing oil under pressure is used to operate this remarkable auto service platform. Compressed air drawn from the same reservoir, used for tire inflation, is used to obtain the necessary pressure.

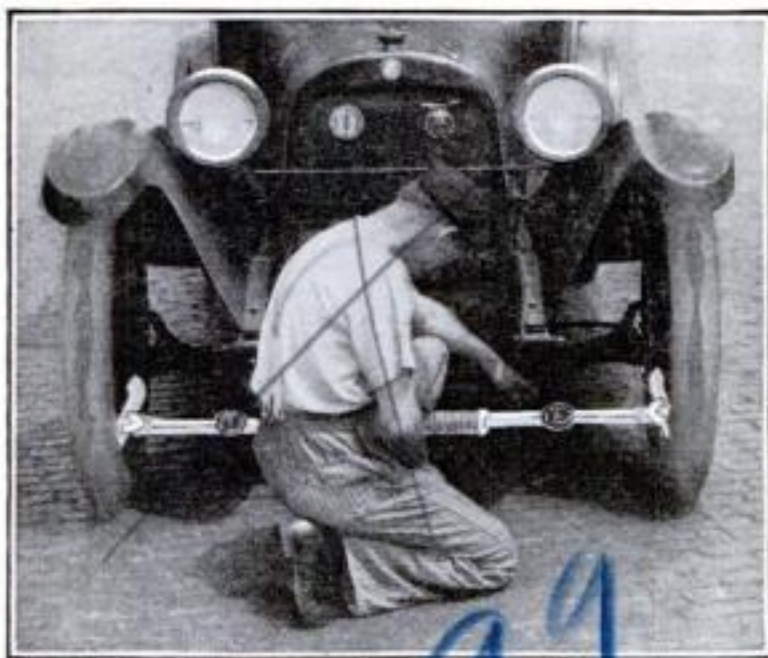
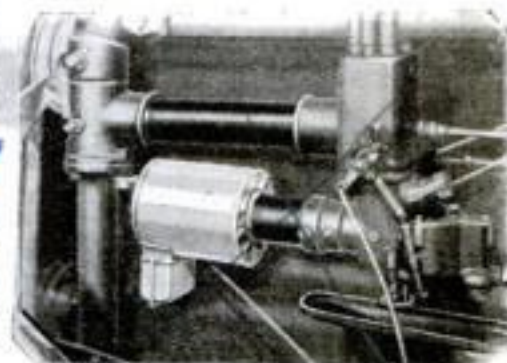


Baggage Trailer for Light Cars

From France comes the solution of the excess-baggage problem. The frame is hinged at the front and the wheel is set at an angle to make it trail properly.

Centrifugal Air Cleaner for Autos

Incoming air is made to rotate rapidly by directing vanes and the dust settles into the detachable container illustrated at the left.

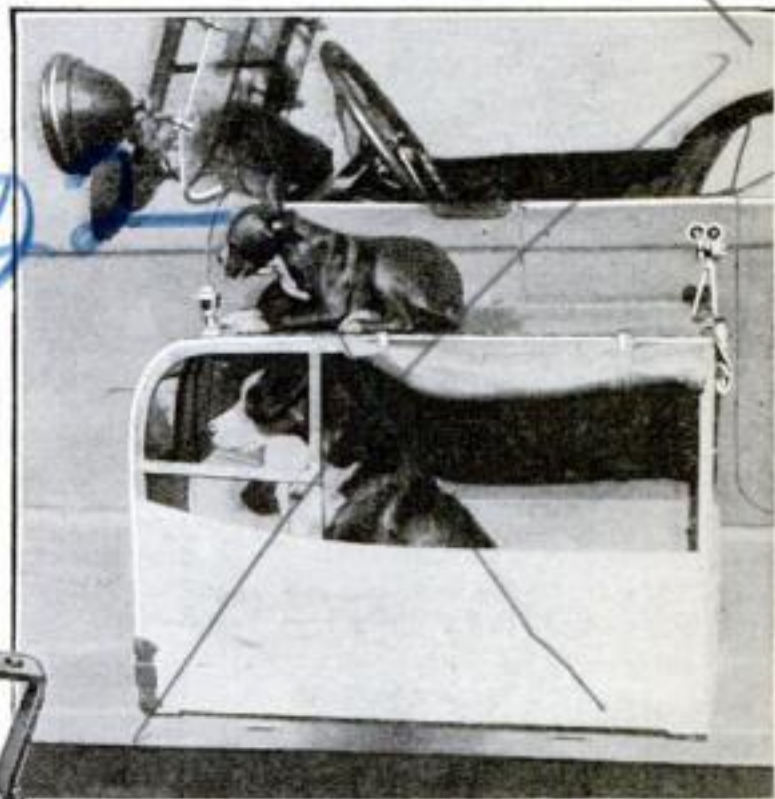
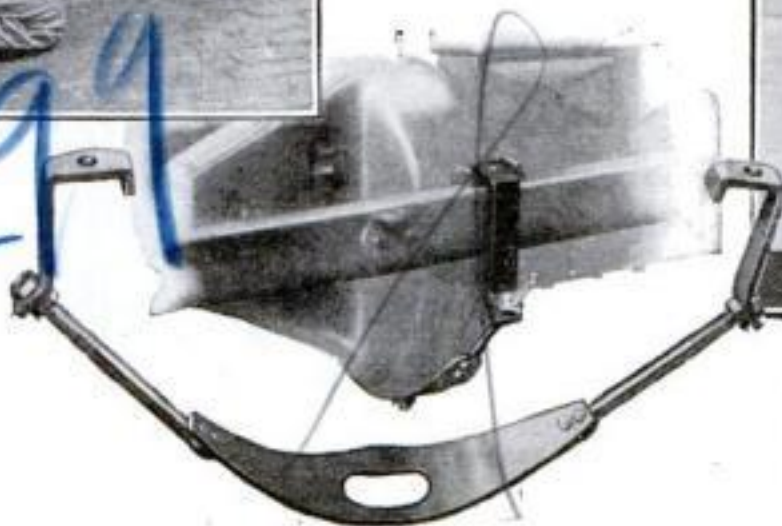


Checks Wheel Alinement

This new wheel aliner instantly shows alinement by pointers on dials. It measures the pitch and the toe-in. The reading on the dials is checked against a chart, which gives correct pitch and toe-in for each make of car.

Ford Crankcase Brace

This brace is applied easily to the crankcase of the Ford engine. It aids in preventing the breaking of the crankcase supporting arms and helps to make the whole assembly more rigid. Vibration is cut down by this means.



De Luxe Compartment for Dog

William Sykes of Los Angeles has had this unique runningboard coupé built for his dog. It has a glass windshield, side curtains, and all the automobile comforts enjoyed by his master.

Are Your Headlights Safe?



How to Adjust Lights

Gus tilts the customer's headlights downward so that no part of the beams will rise above a line on the garage door marking the maximum height permitted by the law

Gus, the Veteran Mechanic, Shows How to Adjust Them to Avoid Dangerous Glare

By Martin Bunn

IT WAS eight o'clock at night, but Gus Wilson and Joe Clark, proprietors of the Model Garage, were still at work. Gus, the mechanic of the firm, was putting the finishing touches on a car he had promised to deliver in the morning to a man who was starting on a vacation tour, and Joe, who ordinarily held up his end of the partnership by taking care of the office work only, had been forced by the midsummer rush of repair jobs to roll up his sleeves and become for the time being a mechanic's helper.

A smart touring-car suddenly shot in from the street and came to a stop in the center of the garage floor.

"Hey, how about some gas?" called out the young chap behind the driving wheel. "I've been tooting my horn out in front for the last five minutes."

"Never heard you, son," responded Gus, while Joe hurriedly wheeled the portable gas tank around behind the car.

Gus stood surveying the car reflectively while the filling process was going on. Then, as Joe began to screw the cap on the gas tank, Gus wiped his hands in a bit of waste and strolled over to the front of the car.

"Say, young fellow," he said, "why don't you fix those headlights? You're due for a ticket if you leave them like that."

"What do you mean, 'fix'?" demanded the owner indignantly. "Those are darn good lights. See how they light up your garage."

"Sure they're good lights," nodded Gus with a grin. "Good for you, that is. But how about

the other fellow? He has some rights, too, you know. Swing your car around so that the lights will be facing the back door, and I'll show you what I mean. There, that's far enough," called out Gus, as the beams from the headlights lit up the whitewashed door. "Now step up close here. See that black line across the door? The law in this state says that no part of the beam should go higher than that. Your lights, though, are adjusted so that at least half the beam is above the line."

"I know that," the car-owner broke in, "but if I tip them down, I can't see the

road far enough ahead when I drive fast."

"Quite true," admitted Wilson. "But you're violating the law just the same. Suppose everybody else thought as you do, and used blinding lights and drove like—er—lightning? Why, there wouldn't be hospitals enough for the victims—or tow cars enough to drag away the wrecks!"

THE days of fast night driving with dazzling lights are gone forever. There are too many cars on the roads now. A driver has to think of the other fellow and adjust his headlights so that he'll get all the light he needs without blinding everybody he meets."

The car-owner smiled derisively.

"That sounds all right," he said, "but it just can't be done."

"It can't, eh?" snapped Gus. "I wish you'd give me five minutes on those lights! If I can't make better lights of them and still have them comply with the law, I'll make you a present of my time—and throw in that gasoline you just bought!"

"Fair enough!" grinned the owner. "Go to it!"

Wilson got a toolkit, stepped to the front of the car, and removed the front flange and lens from each headlight. Then he took out the bulbs and examined them carefully, holding them up to the big electric light in the center of the garage ceiling.

"There—see how much darker one of them is," he said, offering them so that the owner might observe also. "That's caused by little pieces, or mole-

Gus and Joe Save You Woe

THIS is the second of a series of stories by Mr. Bunn, in which his two fascinating characters—Gus Wilson and Joe Clark, proprietors of the "Model Garage," are giving you valuable tips from their long experience on how to run your car efficiently, safely, and with the least possible expense.

If, by chance, you did not meet these two veteran automobile men in last month's issue, this will introduce them to you. Gus, the mechanic of the combination, tells you of the many little kinks that will save you trouble in the upkeep and operation of your car. Joe, his partner, the "figure man" of the firm, has a store of valuable suggestions on how to keep your motoring costs down.

The advice that Gus and Joe will offer each month is of practical use to every automobile owner. Each article in the series will be a complete story in itself. However, if you failed to read Mr. Bunn's first article in last month's issue, in which Gus told how to put your car in summer trim, it will pay you to go back and read it.

And you won't want to miss next month's article, in which Gus will explain little known yet invaluable tricks of gear shifting that will help you get the most satisfaction in driving your car.—THE EDITOR.

cules, or whatever you call 'em, that fly off the hot filament and stick to the glass. A few more days and this dark bulb will be ready to pass out for good."

"Phew, better let me have a new one!" exclaimed the owner. "In fact, you'd better make it two. They've been on

the job more than six months now, and I do a lot of driving at night. Put in good big ones so I'll have a lot of light."

"Nothing stirring," said Gus; "21-candlepower is all the law allows you, and you have that size now. Of course, some of the 'gyp' dealers will sell you bulbs marked with a higher rating than 21-candlepower, but the extra candlepower is mostly in the label on the box!"

"Twenty-one for me then—got two tickets for speeding this year and I certainly don't want another chance to say 'Good morning, judge!'"

"It wouldn't be healthy for your pocketbook," Gus chuckled. "Joe, get out two bulbs—make it three—you ought to have a spare."

WHILE Joe went after the bulbs, Gus carefully dusted out the reflectors with a clean silk handkerchief that had appeared miraculously from a concealed pocket in his greasy overalls.

"Speaking of reflectors," said Gus, "one of those scientific sharps told me once that an automobile reflector that had lost enough of its shininess so that you could tell that it was not quite new would reflect only about 50 per cent as much light as when it was new."

"Well," the owner observed, "who'd expect a rusty old reflector to give much light?"

"Who mentioned rusty junk?" demanded Gus; "I meant a reflector that has lost its first brilliancy—just a bit foggy—not really bad at all. Take your reflectors. They look like new, but I'll bet they've lost at least 10 per cent of their light-reflecting power."

"Well, what can I do about that?" asked the owner.

"Nothing," Gus answered. "Special buffing apparatus is needed to bring full polish back to a reflector, and it takes an expert to run the apparatus. The best way for the rest of us to treat a headlight reflector is to leave it alone. Anyway, never do more to it than dust it off as gently as you can every now and then. Then when the shine goes, after a year or two, send it to some firm that makes a specialty of refinishing auto lamps."

"LEAVING them alone ought to be easy enough," laughed the owner; "but isn't there anything I can do to keep them from getting dim?"

"Yes. Have the front lenses fit as nearly airtight and watertight as possible."



When Dazzling Lights May Spell Disaster

This picture illustrates the danger of up-tilted headlights in blinding the other fellow on the road. The dazzling effect is increased when the car is going over the brow of a hill

"Why not use a rubber gasket in place of that piece of cord, then?"

"Not on your life!" Gus said emphatically. "Don't use rubber on any account. It would make a water-tight fit all right, but after a while the sulphur in the rubber would discolor the silver plating on the reflector. The cord will do the work well enough, provided it is not squashed down so that it does not have any spring left in it."

He fished a screwdriver out of the toolkit, and fitted it to the screwhead that

\$10,000

IF YOU have not yet entered our great "What's Wrong" Contest, turn to page 29 of this issue and read how you can win one or more of the cash prizes.

projected from the center of the back of one of the headlights.

"See what happens to the beam of light when I turn this screw," he bade. Notice how it contracts and then spreads all over the door again. We will leave it where it makes a smooth, uniform band across the door. That happens to be an extra good bulb—nice, even light. It's almost impossible to focus the cheap bulbs some of the 'gypts' sell you.

"There!" Gus said as he tossed the screwdriver back in the toolkit after focusing both headlights properly. "Now we'll see about turning those beams down so that they don't hit the door



Why a Spotlight Is Valuable

It is when you are driving around a sharp curve at night, says Gus, that a spotlight helps to keep you from running somebody down. This picture shows why the driver without a spotlight cannot see persons walking ahead at a turn in the road

above the line."

He examined the lamp bracket carefully.

"This is going to be easy," he said; "the brackets are adjustable, so all we have to do is to loosen up the bolts and set the headlights where we want them. Joe, just hold your hand on the door there so I can see

where the top of the beam ought to come—there, that's right."

"But you have the lights pointed too low now," complained the owner as Wilson tightened the last nut.

"NO, THEY'RE just right. You have to make some allowance for the effect of loading down the back end of the car with three people. You want them right when you have a full load of passengers aboard."

"Gosh, I never thought of that," said the owner after studying the light on the door for a moment. "They seem to give a pretty good light at that. Maybe I won't have to dim them every time I pass another car now that they are on the right side of the law," he suggested.

"Not unless you are going over the top of a hill," said Gus. "That makes the beam shoot up in the air a bit. By the way, why don't you fit a spotlight?"

"What good would that do? The headlights ought to be enough to drive by."

"They are," said Gus, "except when you are going around a sharp curve. In that case a spotlight might help to keep you out of a ditch—or keep you from running somebody down. Besides, a spotlight is a big help in reading road signs at night and in turning the car around or backing into the garage. Of course, it ought to be mounted so that you can throw the beam backward. Spotlights are all right—if you don't use them so that you are a nuisance to every one else on the road."

"SOME people do," said the owner. "I passed a fellow like that last night. He nearly blinded me and then tried to push me off the road in the bargain. However, I think you're right about the good points of a spotlight. If I had one it probably would help me in getting into my own garage. Got any good ones in stock?"

"Sure, some dandies," Joe Clark broke in, instantly alert for anything that might help jangle the cash register.

The customer consulted his watch.

"I can't stop long enough to let you fit one now," he said; "but I'll be in tomorrow—sure. Here, take out for everything," he instructed Gus, handing him a bill. "A fellow can learn something new about his car every day," he murmured thoughtfully.

"He can—and he ought to," responded Gus. "I've had 20 years of it, and I'm still learning."

Simple Jobs Any Motorist Can Tackle

Here Are Handy Kinks

CONSIDERABLE pressure often is required to get the last few inches of bead over the edge of a clincher rim, especially if the tire is new and stiff. The simple arrangement of boards and a piece of rope shown in Fig. 1 will enable you to apply pressure enough to mount the stiffest tire with ease.

If you want to make a permanent job, the shorter piece of board that rests against the tire can be attached to the upper board by means of an ordinary strap hinge.

IF AN electric drill is available, an easily made wire scratch brush will make carbon-removal jobs exceedingly simple and speedy.

Fine steel wire is rolled into a coil about 4 inches in diameter and one side of the coil is bound tightly with brass wire as shown in Fig. 2. Then the coil is cut at the side opposite the binding and the bound portion is forced into the end of a piece of brass tubing attached to a shank that will fit into the drill chuck.

A little soldering flux is dropped into the end, and when hot solder is poured in and allowed to cool, the wire is anchored firmly. If hard steel wire is used, the brush will last for a long time.

A SMALL amount of the initial valve-spring tension is lost through repeated facing of the valve and valve seat. There are two ways to remedy this trouble. One is to stretch the springs, but this method does not always work, because springs that are stretched tend to get back to their original length after they have been in use for a short time. Another way to increase the tension of the valve springs is to place washers at the upper or lower ends of the springs as shown in Fig. 3. The upper position is preferable because it does not add to the moving weight.

Be careful to see that the washers seat squarely, for if one side is cocked up, the resulting side pressure of the valve spring will cause excessive wear on the valve guide.

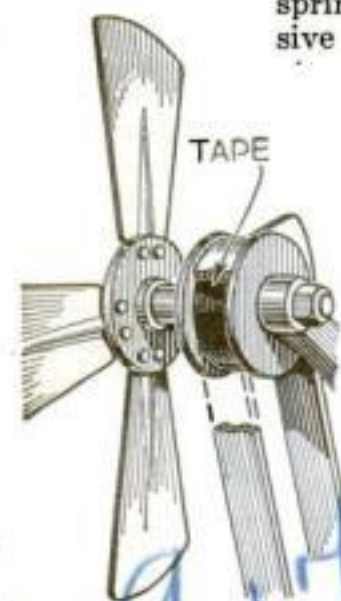


Fig. 6—Friction tape will help to cut down fan-belt troubles if properly applied

IN FIG. 4 is shown a good way to make a universal wheel puller that will work on any auto wheel regardless of the dimensions of the threaded portion. The shell of the wheel puller is made of 4-inch extra heavy iron pipe. A piece of 1/2-inch flat steel is fitted into one end and welded



Fig. 1—Giant "nutcracker" is great help in mounting a stiff new tire on the clincher type of rim

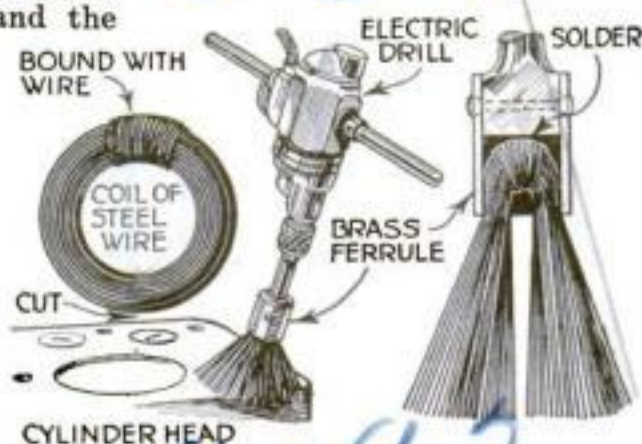


Fig. 2—This electrically driven scratch brush of simple construction makes carbon removal an easy task

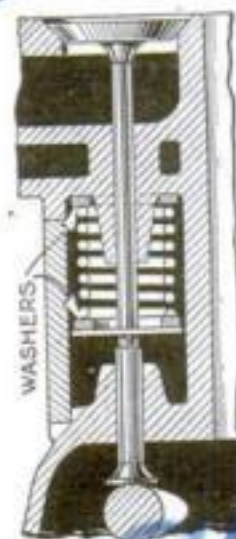


Fig. 3—Where washers are inserted to increase tension of valve springs



Fig. 4—This homemade universal wheel puller will remove the rear wheel from a car of any make

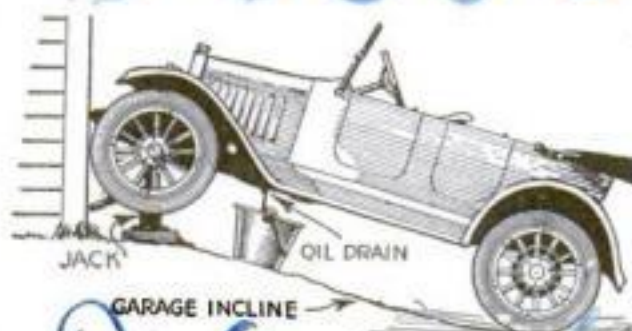


Fig. 5—Running the car up an incline and jacking the front wheels simplify the job of drawing oil from crankcase

into place. A 13/16-inch hole is drilled in the center of this plate and a 3/4-inch S. A. E. nut welded to the plate at the inside end of the hole.

At the other end of the pipe, six holes are drilled and threaded for 3/4-inch S. A. E. cap screws. The wheel puller is used by tightening the six screws against the wheel hub as shown in the illustration.

to Make Work Easier

When pressure is applied to the center of the axle by means of the long center screw, the threaded flange prevents the wheel puller from sliding off, and the tightest wheel can be removed.

THE man who takes pride in his automobile makes a practice of draining the crankcase about every 500 miles. This is a messy job at best, but it will make the work easier and the draining more thorough if the front of the car is run up the incline to the garage as shown in Fig. 5.

If the incline to the garage is not great enough, then it will be worth while to jack up the front of the car as indicated. This will make it much easier to get at the drain plug with a wrench, and tipping the motor will drain out the oil in the splash pockets under the connecting rods.

Another advantage is that the oil can be run directly into a regular bucket rather than into the shallow pan that often is necessary because of lack of clearance under the crankcase.

FLAT fan belts frequently give trouble through slipping or coming off the pulley. Both these troubles often can be eliminated by winding tape around the center of the pulley so that the center is larger in diameter than it is nearer the edges. The belt then will have a tendency to run on the center of the pulley and the tape will cut down the slipping. Another advantage is that if the belt runs squarely on the center of the pulley, it will not wear away the rim or the flange.

IT IS easy to make a set of wooden jacks that will keep tires off the floor.

The jack illustrated in Fig. 7 is designed on the "knuckle joint" principle, using an ordinary strap hinge as a knuckle. A 4-by-4-inch block serves as a base, held to the lower member by spikes. To prevent the length of 3/4-inch pipe, used as a detachable handle, from hitting the hub cap when the jack is raised, a space block is attached to the front of the lower member.

The jack is shoved under the wheel, back of the hub cap, as shown in the illustration. Then the pipe handle is inserted in the hole and the top end of it pushed toward the car, and the wheel is raised to height desired.



Fig. 7—Simple jack to keep tires off the ground when the car is stored



The Home Workshop

Arthur Wakeling, Editor

A Playhouse to Delight Small Girls and Boys

Built like a Real House with Ample Space for Toy Furniture

CHILDREN never seem to become tired of playing house, even if they have nothing more than the back porch or a discarded table to represent the house. But their joy in this old play-time stand-by is far greater if they can have a miniature house of their own, large enough for them to enter, with real doors and windows—a house that will hold their tiny furniture, their toy kitchen range and dishes, and all their big family of dolls.

Such a house, if carefully built, neatly lined with fiber wallboard, and well painted, helps to solve the difficult problem of keeping the children from wandering away from their own yard, perhaps to play in streets ever becoming more hazardous with the traffic of autos and heavy trucks.

Details for the construction of an especially realistic and substantial playhouse



are given in the drawings below. It was designed by George F. Kaercher of Philadelphia, a recognized authority on woodwork, who is known to readers of POPULAR SCIENCE MONTHLY through his contributions to the Home Workshop series of blueprints.

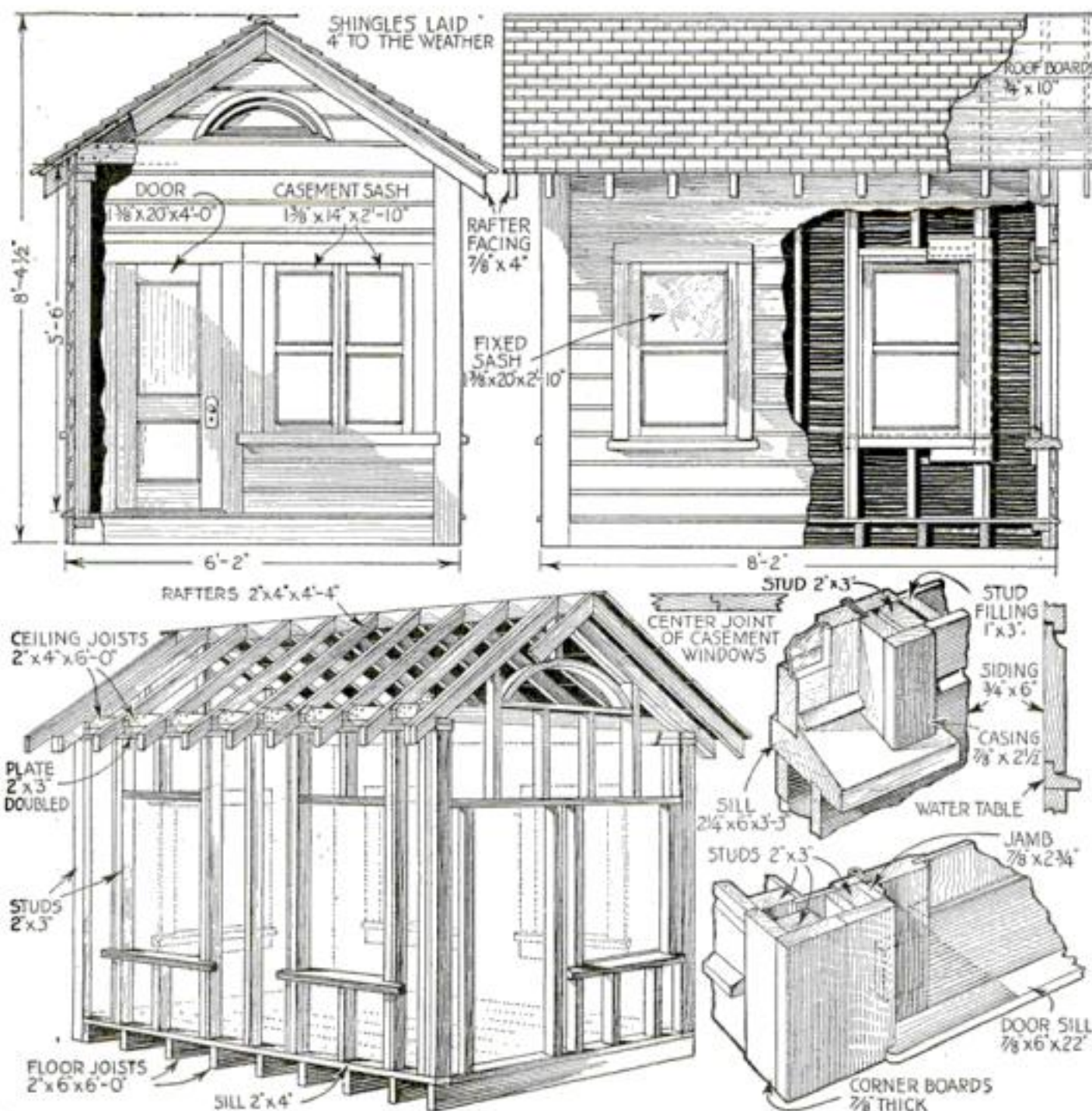
The house is 6 ft. 2 in. wide, 8 ft. 2 in. long, 8 ft. 4½ in. high to the top of the roof, and 5 ft. 6 in. high from floor to ceiling. It has a door and a double casement window in the front, another casement window in the back, and two fixed windows on each side. There are also two small ornamental upper windows in front and back.

While the use of so many small windows makes the house seem more like a real building, considerable work can be saved by reducing their number. A door and casement window in the front and one fixed sash in each side will serve.

The sash can be purchased ready-made from your lumber dealer, and it is well to find out what stock sizes he has on hand so that you can make the framework to suit. The casement sash, which are, of course, hinged, can open either in or out. The children prefer to have them open in, but it is easier to make them water-tight if they are hung so as to open out.

It is possible, too, that you can obtain a cupboard door that will serve for the front door, if well painted. It is a simple matter,

(Continued on page 101)



Front and side elevations of the playhouse broken away to show the wall, floor, window, and roof construction; the method of framing and details of the casement windows at front and back, the door, and the water table

THIS month's Home Workshop Department will be found on pages 75 to 80 and 85 to 101, The Shipshape Home on page 84, and The Better Shop Methods Department on pages 82 and 102 to 108.

Upholstering the "Hard Edge" Way

How This Simple Method Is Applied to a Stool or Seat

By William T. Weld

Shopwork Instructor
Central High School, Peoria, Ill.

STRANGE as it may sound, the so-called "hard edge" type of upholstering gives a comfortable seat. An example of this simple method of upholstery is the footstool illustrated, which also might serve as a fireside seat.

Many old-fashioned chairs, as well as some of the later styles, have seats with a hard edge. You are apt occasionally to have to repair a chair of this kind. That will prove a simple matter if you will construct the stool shown or even if you do nothing more than study the illustrations and the following suggestions carefully enough to learn the distinguishing points of this class of upholstery.

Any soft wood will serve for the rails of the stool (Fig. 1), as they are covered, but the four legs, the two lower end rails and the stretcher should be made of a hard wood such as oak or walnut. Casters may be inserted in the legs, if desired. All the woodwork and the finishing should be done before commencing the upholstery.

As they appear in Fig. 2, from left to right, are the following necessary tools and supplies: sheet wadding, box of gimp tacks, a roll of gimp, springs, spring twine, webbing stretcher, curved needles, double-pointed needles, stuffing regulator, hammer, shears, webbing, and kapok for stuffing.

In an article of this series published last October in POPULAR SCIENCE MONTHLY (page 86) it was explained in detail how to attach the webbing and stretch it into

place. Figures 3 and 4 show how the seat appears when the webbing is tacked in place and the springs sewed to it. The springs used in this seat are size No. 3, 5½ in. across. The webbing is 3½ in. wide. How the springs are tied in place is

illustrated in Fig. 5. The knot (clove hitch) used for tying springs was described in the May issue of POPULAR SCIENCE MONTHLY (page 104). The twine is fastened with 12-oz. tacks.

After the springs are tied, a piece of heavy burlap is placed over them and tacked along the edge of the rails where the wood has been rabbeted out as shown in the drawing (Fig. 1). Upon this burlap is placed the stuffing. Flax tow may be used and for a seat of this size about 4 or 5 lbs. will be needed. Pick out any hard lumps and spread it evenly over the seat, allowing about 2½ or 3 in. of it to protrude beyond the seat frame. Keep the surface of the stuffing reasonably level and the edges well filled out.

Over this is laid a piece of lighter-weight burlap. The stuffing is pushed in along the edge and the burlap is slip-tacked to the frame. By slip-tacking is meant driving tacks only partway in so that they may be removed easily as the burlap is drawn down over the stuffing while it is being worked into position. Use a stuffing regulator to work the tow whenever the proper shape of the edge cannot be secured by working along the edges.

When the burlap has been slip-tacked along the edges, it is well to take several rows of stitches with the double-pointed needle through the two thicknesses of burlap and the tow. These stitches should be 2 or 3 in. long and the outer row should come just outside the outer edge of the springs. Be careful in

(Continued on page 97)



Fig. 1—The finished footstool (above) and the details of the wooden framework (below)

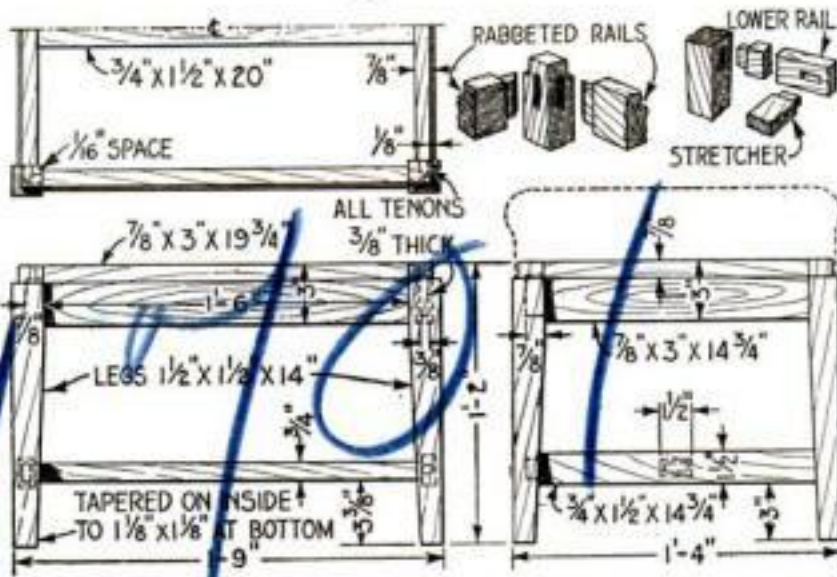


Fig. 2—The tools, webbing, stuffing, gimp, wadding, springs, twine, and other supplies needed for hard-edge upholstery, all of which are relatively inexpensive

Fig. 3—After the webbing has been stretched and tacked across the bottom, the springs are put in place and held with long stitches

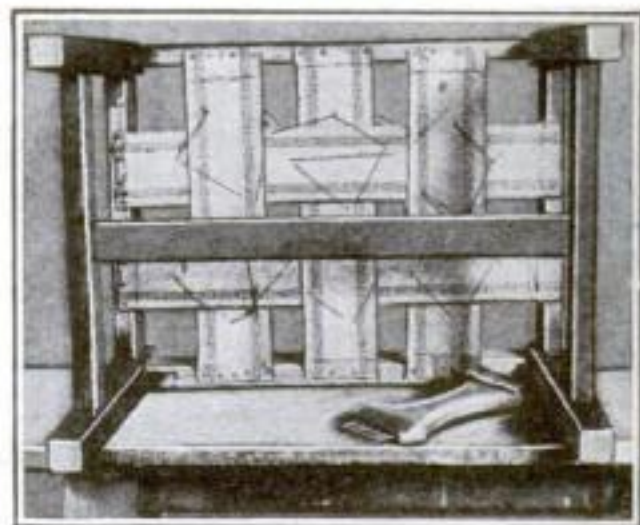


Fig. 4—The bottom of the stool, showing the webbing and the stitches that hold the springs

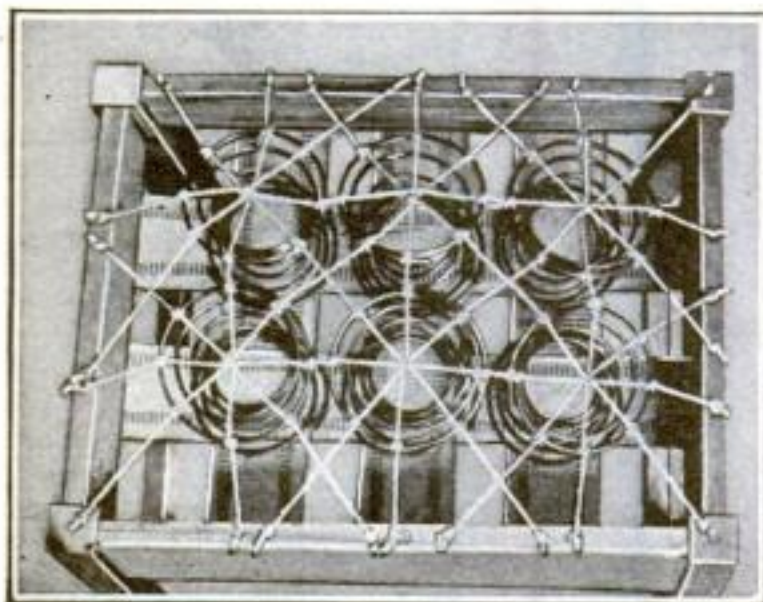


Fig. 5—The springs are tied down with lengths of twine, the ends of which are tacked very securely to the frame

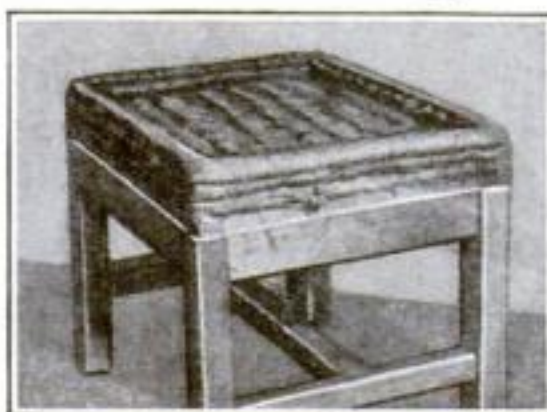


Fig. 6—The stuffing, covered with burlap, is sewed to form an erect edge

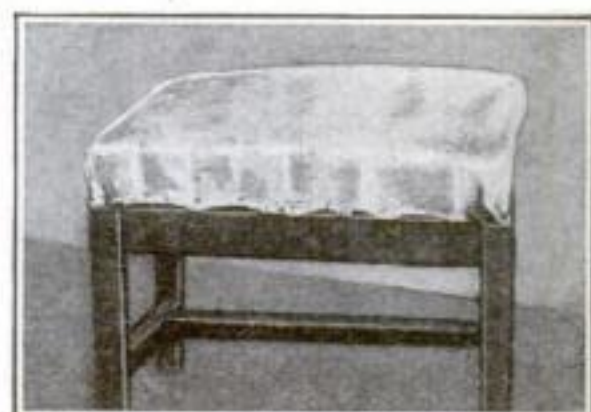


Fig. 7—The center is filled with stuffing and covered with wadding and muslin



Branch of Tree Serves as Garden-Tool Rack

SPADING, hoeing, raking, digging, and miscellaneous chores of the amateur gardener require the intermittent use of various gardening tools. For keeping the tools handy, the device illustrated has proved useful to the writer. A long, stout branch or a small, scrub tree, pointed at the lower end, is thrust into the ground within convenient reach. An old Christmas tree serves well for this purpose.—A. E. ZIPPRICH, New York.

Trail Markers for Hikers



ROCK markers consisting of two long stones laid close together with a flat stone over the top are excellent guides for campers and hikers. They are used like a gun sight. The hiker looks through the hole, or over the top of the flat stone, in the direction pointed out, and sees the next signboard or marker at the point where the trail enters the woods ahead.

On wide open spaces, two or three of these sighting points may be placed in succession.—ARMSTRONG PERRY.

An Electrified Dining Cabinet

Serves as kitchenette, table, and cupboard, yet looks like a fine cabinet when closed

By Martin H. Ellingson

AN ELECTRIC dining cabinet is what I call the piece of furniture illustrated in the accompanying photographs. It just has been completed and was inspired by the many useful innovations built by contributors to POPULAR

is supported on a hinged framework, as shown, to form a dining shelf. The case is stained a moss green and waxed. So that it can be moved easily and noiselessly, it is mounted on heavy ball-bearing casters. Electric outlets for attaching such cook-



SCIENCE MONTHLY and described in your past issues.

For any one with limited room in his home, a more useful article of furniture hardly could be constructed. It provides a complete electric kitchenette with dining shelf attached, and has ample store-room for food, utensils, and dishes. When not in use for cooking or dining, it can be closed completely and pushed against the wall, where it has every appearance of being a fine piece of living-room furniture.

When closed the cabinet measures 4 ft. long, 4 ft. high, and 17 in. deep. It is built from 3-ply veneer panels and odd lengths of old oak molding. The front panel is removed bodily to open the cabinet and half of the back drops down and

ing appliances as the coffee percolator, toaster, chafing-dish, and stove are connected by concealed wiring with an outlet on the outside of the cabinet near the bottom, and this in turn is connected with an electric cord to a convenient base or floor outlet whenever a meal is to be prepared. An electric lamp also is included in the permanent wiring of the cabinet.

Three views of the cabinet, showing dining shelf, the electric equipment and storage compartment, and as it appears when closed

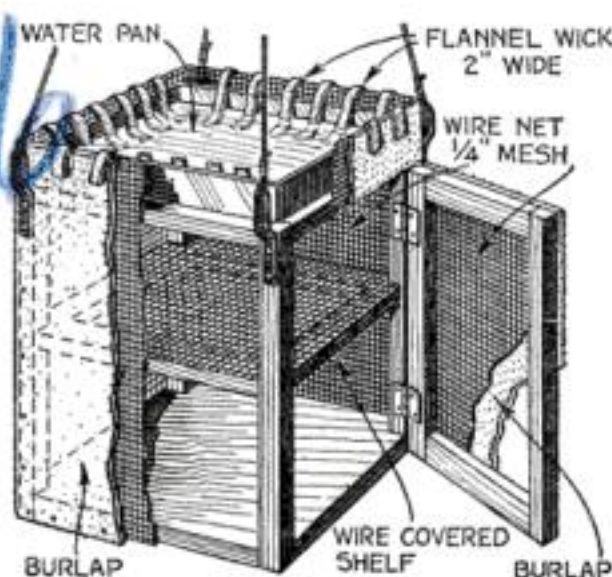
This contribution was submitted in POPULAR SCIENCE MONTHLY'S recent Photo Handicraft Contest and was given honorable mention by the judges.

If you have followed with interest this and other Home Workshop contests, do not overlook the great \$10,000 contest announced on pages 29-31. Anyone who reads this department attentively should have no difficulty in telling what John is doing wrong in each of the puzzle pictures.

Simply Made Iceless Cooler Preserves Campers' Food

IDEAL for campers' food is what is known as an "Arizona ice-box." A frame is constructed as shown and covered with galvanized-iron netting, which runs 4 or 5 in. above the top. The outside netting is covered with two thicknesses of burlap and a tin pan is made to fit in the space on top of the box.

The box should be suspended by wires or ropes from a tree or scaffolding. About two dozen strips of flannel, 2 in. wide and long enough to reach from the bottom of the water-pan on the inside to about 3 in. down from the top on the outside, are arranged in the pan as indicated. When saturated, the strips transmit the water to the burlap, where it spreads over the



surface of the entire box. The evaporation of this moisture absorbs the heat in the box and in dry, hot weather keeps milk or butter equally as well as ice does.

If the water seems to evaporate too rapidly and leaves the lower surface dry, put on another covering of burlap. A handy arrangement is to keep the box near a faucet and let the water continually drip into the pan.—E. G. G.

Finds Blueprints Helpful

INOW am building a tea-wagon from one of your blueprints. They sure are a big help to any one who has a home workshop. As soon as I get this done I'm going to try another print.—F. E. F.

Home Workers Show Their Skill

Prize Contest Photos Offer Many Suggestions for Craftsmen

IF YOU have been hesitating about making those new doors for the kitchen cupboard or building that long contemplated radio cabinet because the task seems a difficult one, take courage and inspiration from the photographs below. They show the best product of other home workers who, perhaps like yourself, began with only a small equipment of tools.

What can be accomplished in the way of making useful and beautiful objects

in the home never was illustrated better than in POPULAR SCIENCE MONTHLY's recent Handicraft Photo Contest. With the exception of the prize-winning contributions published last month, these photos were the best received and were awarded honorable mention.

There seems to be an especial fascination in building inlaid tables. Many excellent examples were received, among the most elaborate of which are the four tables illustrated on this page.

The phonograph is unusual because of the use of a violin as a sound chamber to improve the tone. The ship model has the distinction of being only 3½ in. long, although complete to the last degree.

Each block is moved correctly and there is a man at the wheel and a lookout on the forecastle.

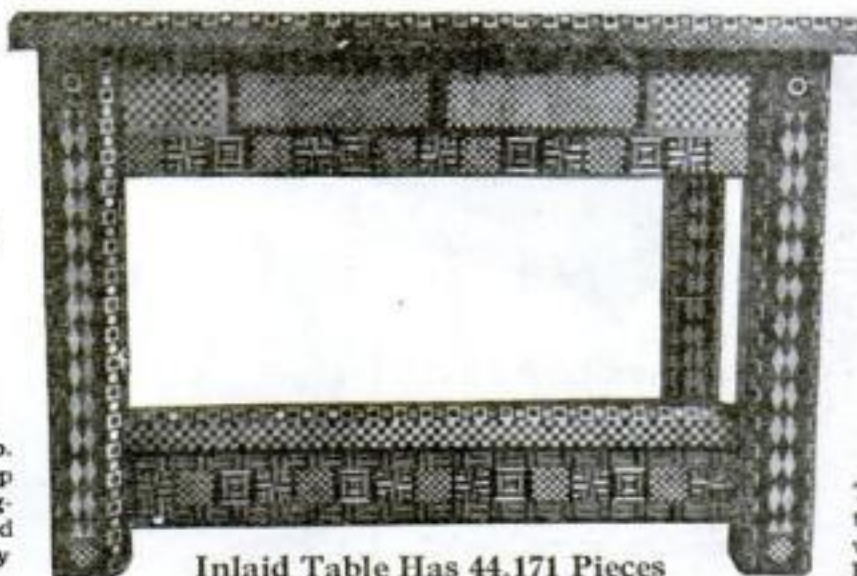
The candlestick holder and table lamps are carved from wood and beautifully finished. The candle is silver and blue with a base of old-gold color stippled in polychrome. The lamp stands also are in polychrome over gold.

Eight months' spare time was required in making the model of the moon. A chart with key numbers is used to locate the 700 principal features.



Library Table

Built by William Buehler, St. Louis, Mo. Contains 144 pieces of four woods. The top is 20 by 44 in., with three stars of mahogany and maple inlaid in walnut, and placed in a double border of mahogany and holly.



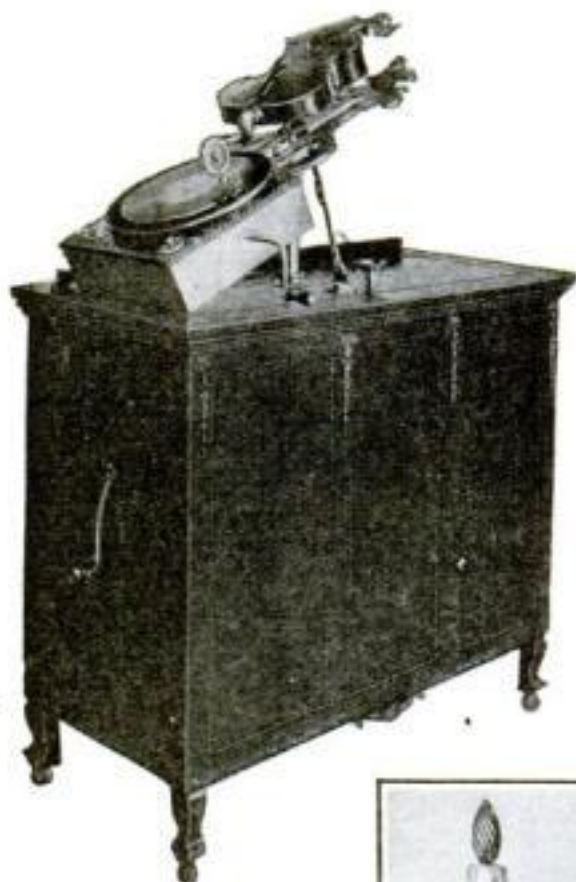
Inlaid Table Has 44,171 Pieces

Twenty varieties of wood were used by John Wharton, of Dayton, Ohio, in carrying out the color scheme of this table, which was built with ordinary hand tools. Five years were required in its construction.



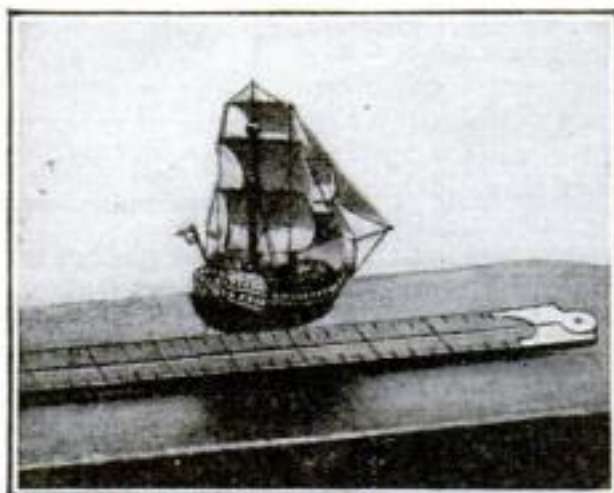
Six Years' Work

This table, which contains 20,505 pieces, more than 18,000 of which are in the top surface, was built by W. W. Flanigan, engineer at the Branch Agricultural College of Utah, Cedar City, Utah. Ninety-one varieties of wood were used and the work took six years in all.



A "Violagraph"

Built by Charles H. Fernald, of Malden, Mass. When not in use, the violin sounding device is lowered by turning the crank and is completely concealed by the cover.



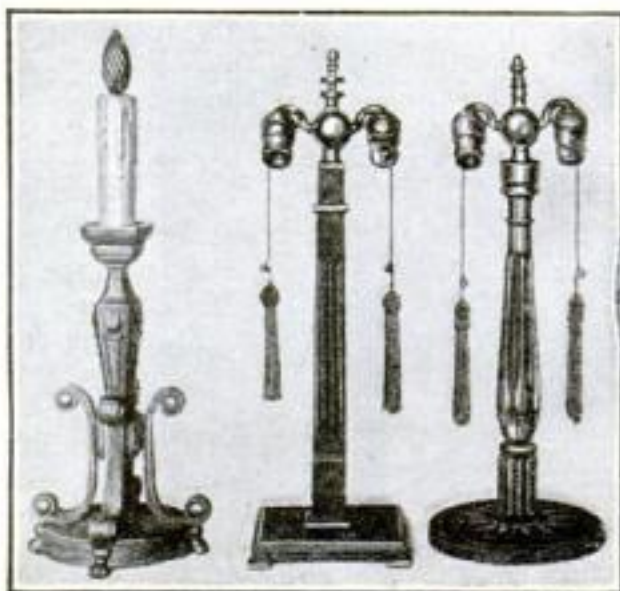
Miniature Ship Model

A miniature ship built with penknife and darning needle by Douglas H. Burt of Indianapolis, Ind.



Pedestal Table

A pedestal table made entirely by hand by H. F. Burt of Wichita, Kans. It has 6516 pieces of 18 different woods. The largest pieces are only ⅜ in. wide; the smallest, 1/32 in. wide. The top is 20½ in. square and the table stands 27 in. high. Mr. Burt spent a few hours a week for six years in assembling and finishing it.



Lighting Fixtures

Hand carved wooden candlestick and two table lamps made by William Buehler, who constructed the library table above.



Model of the Moon

Plaster-of-Paris model of the moon 12 in. in diameter. It was made by Herbert B. Collier of Viking, Alberta, Can.

How to Give Furniture a Beautiful Finish



For a blue print of this attractive combination Book Rack and End Table send us 25c in coin or stamps.

The Johnson Book gives complete instructions for finishing new and refinishing old wood—soft or hard. This book is the work of experts—beautifully illustrated in color. Ask for a free copy at your best paint or hardware store.



Stores displaying the above sign carry a full line of Johnson's Artistic Interior Finishes. They will give you a free copy of the Johnson 25c Book on Home Beautifying and are competent to answer questions and give advice on the proper finishing of wood. These stores will gladly show you panels of wood finished in many beautiful effects.

AFTER spending precious hours making furniture by hand you naturally want to give it a beautiful finish. And surely the finishing should receive its share of attention, for a beautiful piece of furniture may be ruined if improperly finished, whereas any small defects are minimized in a well-finished piece. So the finishing of your furniture becomes a matter of prime importance.

First apply a coat of Johnson's Wood Dye. With this you can color the wood any one of 17 beautiful shades. Johnson's Wood Dye is very easy to apply—it dries in four hours and will not rub off or smudge. Penetrates deeply, bringing out the beauty of the grain without raising it.

Open grained woods (oak, chestnut, ash, mahogany, walnut, etc.) should then be given a coat of Johnson's Paste Wood Filler followed by a light

coat of Johnson's Under-Lac or pure white shellac. The furniture is then ready to be finished—either with two coats of Johnson's Prepared Wax or Johnson's Varnish. For close grained woods (pine, cypress, maple, birch, etc.), omit the Filler coat.

Follow these instructions for finishing furniture and you will be assured of perfect results—the thrill of pleasure when the work is new and yearly satisfaction at its wearing qualities.

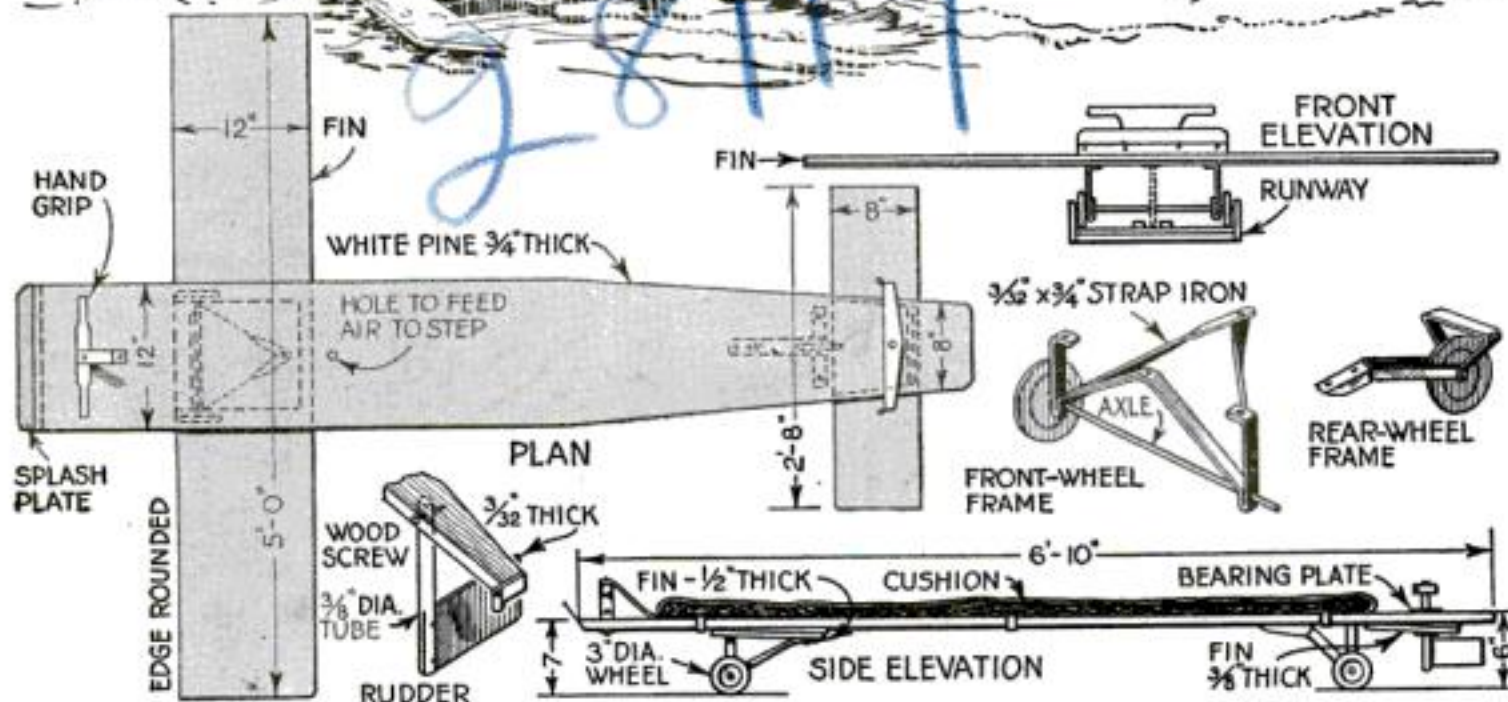
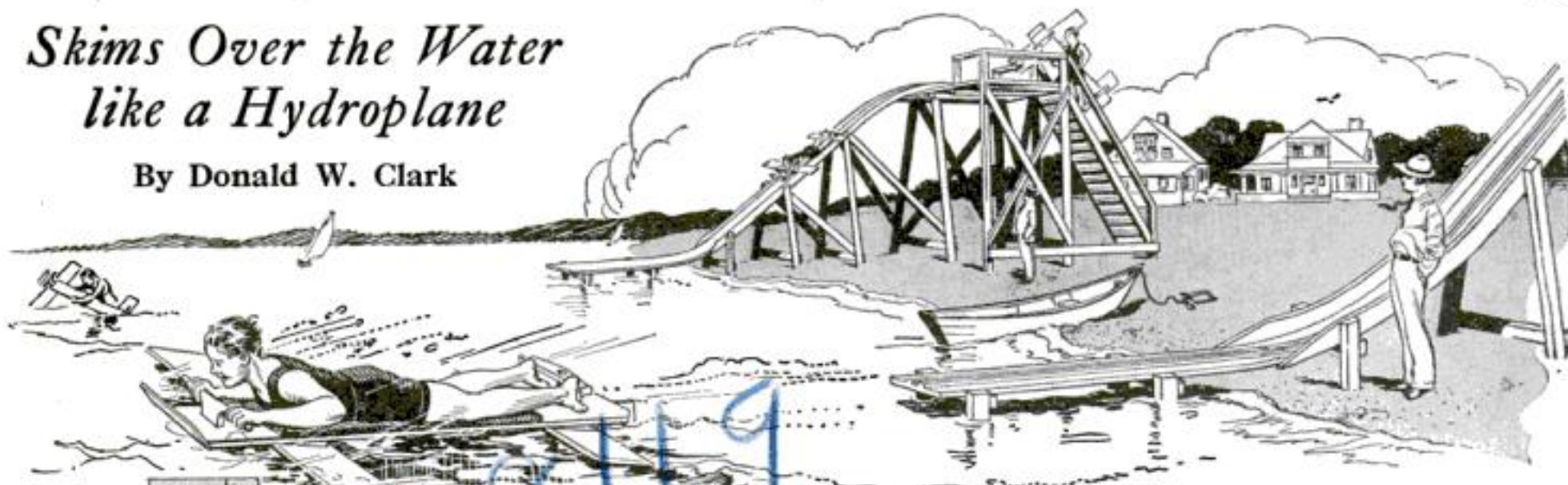
S. C. JOHNSON & SON, "The Wood Finishing Authorities" RACINE, WIS.

JOHNSON'S WOOD DYE

Glider Adds Zest to Swimming

Skims Over the Water like a Hydroplane

By Donald W. Clark



This speedy water glider furnishes rare sport for the summer camp. The swimmer shoots down the 40-deg. incline and skims over the water, steering himself by operating the rudder with his feet. When the glider loses speed, it no longer supports the rider and sinks below the surface. The rider then swims to shore, towing the glider, and, placing it under his arm, climbs the steps ready for another "skim." The incline is built mainly of 2 by 4's and 1 by 4's. The glider itself, which is fully detailed, should be well painted and varnished. A long, canvas-covered cushion should be made to fit the glider and fastened in place with straps.

Washstand, Oven, and Frying-Pan for Camp



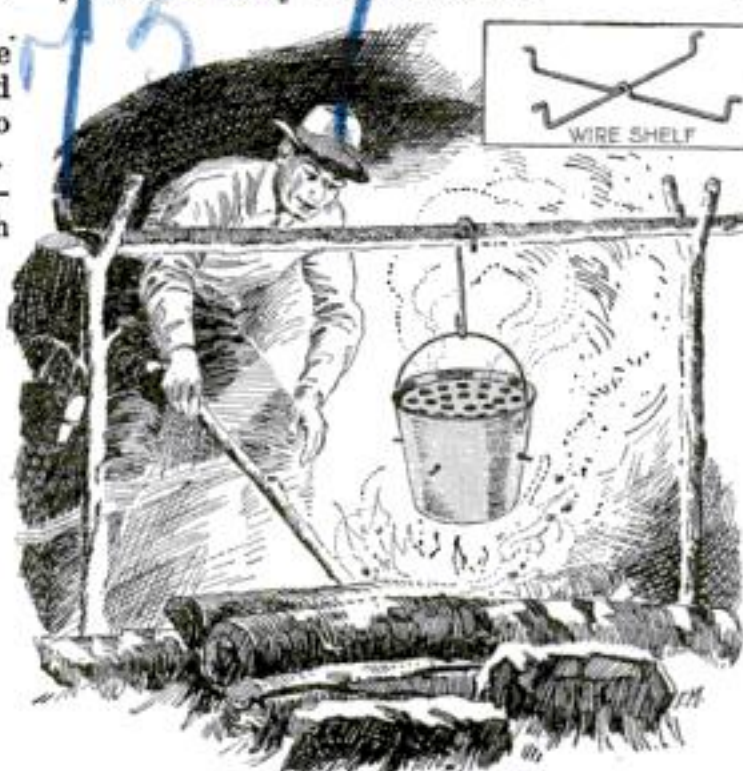
Wash-basin supported by three branches

WOMEN folks in camp especially appreciate a good stand for the wash-basin. By utilizing the materials of nature as shown at the left, a washstand can be made right on the spot.

Cut down three large saplings and trim them all to about 5 ft. so the butt includes one branch that forks out at about the angle indicated. Remove these offshoots about 6 in. from the trunk and then turn the resulting sticks upside down so the butts and crotches are uppermost and the shortened branches point in. Drive the stakes into the ground until the butts stand about 30 in. above it and equal distances apart.

THERE is never any necessity for unpalatable food in camp through lack of cooking utensils. Even baking can be done successfully with nothing more than an old water-pail

for an oven. Provided it has ears and wire handle, a pail makes a good oven. About halfway down, punch four $\frac{3}{4}$ -in. holes in it, bend two cross wires as shown, and spring them in place. These make a shelf for supporting a pan of biscuit or other camp bread while baking. Make a tin cover to fit the pail and punch a number of $\frac{3}{4}$ -in. holes in it. Hang the oven by means of a wire or small chain from the cross bar of the camp fire, or place it directly over the coals.

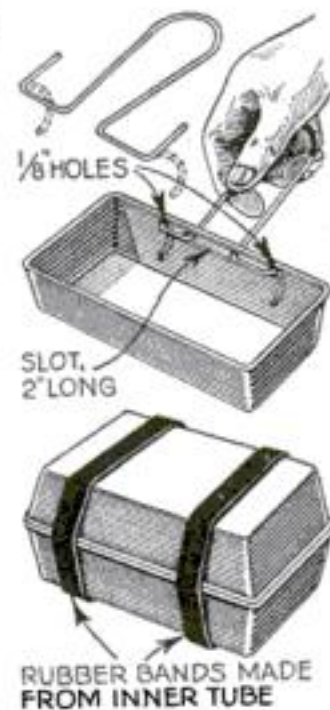


An old water-pail with wire shelf and perforated tin cover forms an excellent oven for camp baking

A pair of square frying-pans may be made from two ten-cent sheet-iron baking-tins about 2 by 8 by 10 in. in size. Punch two $\frac{1}{8}$ -in. holes in one of the longer sides of each tin as shown, about 3 in. from the ends.

Cut a slot 2 in. long in the same side directly beneath the edge wire. The slots allow the wire handle to be slipped through before the bent ends are inserted in the holes. One of the pans can be used for heating water if the two are not needed for frying. Baking can be done by placing one pan on top of the other.

Placed face to face, held together by rubber bands made from an old automobile inner tube, and slipped into a close-fitting canvas bag, these pans form a good size container for supplies. They will hold their own handles and some utensils, as well as the less bulky eating supplies.



Frying-pans made of baking-tins



-and then YOU will share their pride in this Saw

YOU can still buy a hand saw that is the personal product of a craftsman's hands—and in which you can take a craftsman's pride.

Though the world's greatest saw works is alive with modern machines—many of them invented and built here in the Disston plant—

The fame of "The Saw Most Carpenters Use" rests square on the skill of the Disston workman.

The Disston Hand Saw seems alive as you use it. Perfect balance is the secret of its easy thrust and swing. Only Disston workmanship balances a saw that way.

The Disston Saw follows true on the line. The skill of a Disston saw-maker made it true.

It holds its cutting edge. Disston

workmen made the steel in that keen blade, hardened and tempered, set and sharpened it.

Henry Disston's first saws won their way on workmanship.

And so, when your Disston Saw makes hard work easy, you are getting a result that generations have worked to give.

What to expect of your Disston

The springy, tempered Disston Steel blade that holds its keen edge so long—

The true, clean, easy cutting that is so quickly done—

The balance and swing that make it seem as a part of your arm—

These are the things that Disston saw-makers, aided by improved

methods and modern machinery, work into the Disston Saw.

Go to the nearest hardware store. Take a Disston Saw in your hand. Read the promise etched on its shining blade.

Test that promise in use.

Try this saw on hard wood or soft, rough or fine work, for speed, ease and clean cutting.

Then you will understand and share the pride of the men who make the Disston Saw!

Ask Disston

Tell us what kind of work you are doing, in wood, metal, stone, ivory, rubber, leather, cloth, fibre or other material, and we will tell you how to saw it better and easier. Disston issues many books to aid the user of saws and tools.

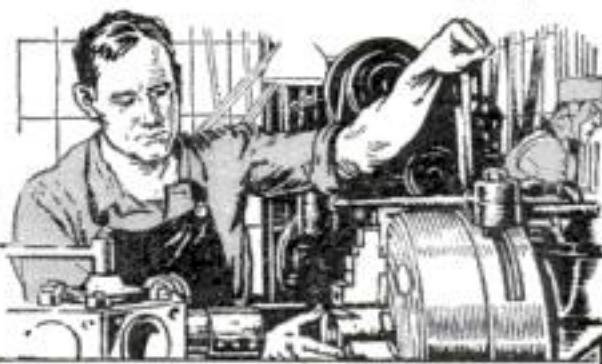
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DISSTON

Better Shop Methods

How Expert Mechanics Save Time and Labor



Old Bill Babbitts a Bearing

By James Ellis
Machine-Shop Superintendent

"**H**ERE is a nice piece of work," Old Bill said to Bob Laten, pointing to a blueprint. "The casting came in from the foundry this morning."

"I wondered what it was," Laten responded.

"It is to be fastened to the old bracket over by the door," Old Bill continued. "Let's go and look at both pieces."

"Now, you see," Old Bill said, pointing to the details on the drawing, "this new casting is to be bolted to the old one so that they will make a frame for a pair of miter gears. The customer did not send the gears, so you will have to locate the center lines accurately."

Laten was looking at the new casting.

"It will be hard to hold this in the shaper," he suggested. "It will be so far up from the vise that I will not be able to make much time on it."

Old Bill studied the casting.

"I think it would be best to do the shaper work on a lathe," Old Bill said. "You can chuck the casting by the round hub and square up everything from the face of the chuck, then face off the ends."

Laten nodded assent.

"I can face off the thrust bearing for the gear at the same setting," he said.

It was some time after lunch when Old Bill next saw the job.

"I don't know what they are there for," Laten remarked, pointing to the two setscrews on each side of the new casting, "but I am putting them in."

"The designer had you in mind when he drew them," Old Bill said.

"**T**HE easiest way to get this drilling done is to drill and tap those setscrew holes first and put in the screws. Then you can put the new casting on the old one and hold it with the screws. Drill all the other holes. Use a 17/32-in. drill for the stud holes, drilling them through both castings, and ream out the old casting to fit the studs. Then drill the bolt holes and the oil hole."

Old Bill looked at his watch. "Make the best time you can on this job, Bob," he added. "I got the job because I made the lowest price. I think I allowed four hours for all the machine work."

The customer for whom Old Bill was doing this work came in to see how it was getting along. A young man, but Old Bill had found him to be full of mechanical sense, and liked to hear him talk about his problems.

"Looks as though you will have it done

for me in the morning," he commented. "I shall have it before then if nothing happens," Old Bill replied.

"A very important thing is to get the shafts at right angles," said the man.

Old Bill smiled. He realized why he was being told something he knew. Old Bill himself constantly told his men things that they should know already. He was aware that men forget the little details just at the most important time.

"We will babbitt this in about half an hour," Old Bill said. "Stay around and see if we do it to your satisfaction."

The customer waited. In the back of

the shop was a forge that Old Bill used for melting babbitt. Near by was a planed surface plate. In a rack arranged according to sizes were a number of shafts used for babbitting mandrels.

Laten brought the castings back and laid them on the plate. He selected two of the shafts, both 1 15/16 in. The longer of the two he put through the bearings in the original bracket. The shorter one he put in the new casting. He blocked up the castings so that the bearing he was to pour was vertical. Then he started to melt some babbitt.

He found a set collar to put on the mandrel he was using. Then, with a small square he adjusted the shafts so that they were exactly square with each other. It was simple to get them in line, for they were both the same size.

The customer, looking on approvingly, said to Old Bill, who had just approached:

"You seem to happen around whenever anything important is going on."

"Well, that is one of the things that I am supposed to do," Old Bill replied. "I get the blame if it is not right, so I try not to be blamed."

The set-up was finished. Laten used a putty made of asbestos and oil to prevent the molten metal from running out. Old Bill explained that it would not sputter and blow as plain mud would.

"**A**NOTHER little trick that may be useful to you some time is a method of pouring babbitt in wet places," he continued. "A few days ago we were making some repairs to a concrete mixer that had burned out a bearing. It was out in the open and rain was falling. Of course there was water in the box, but we poured it without having the steam blow out all the babbitt."

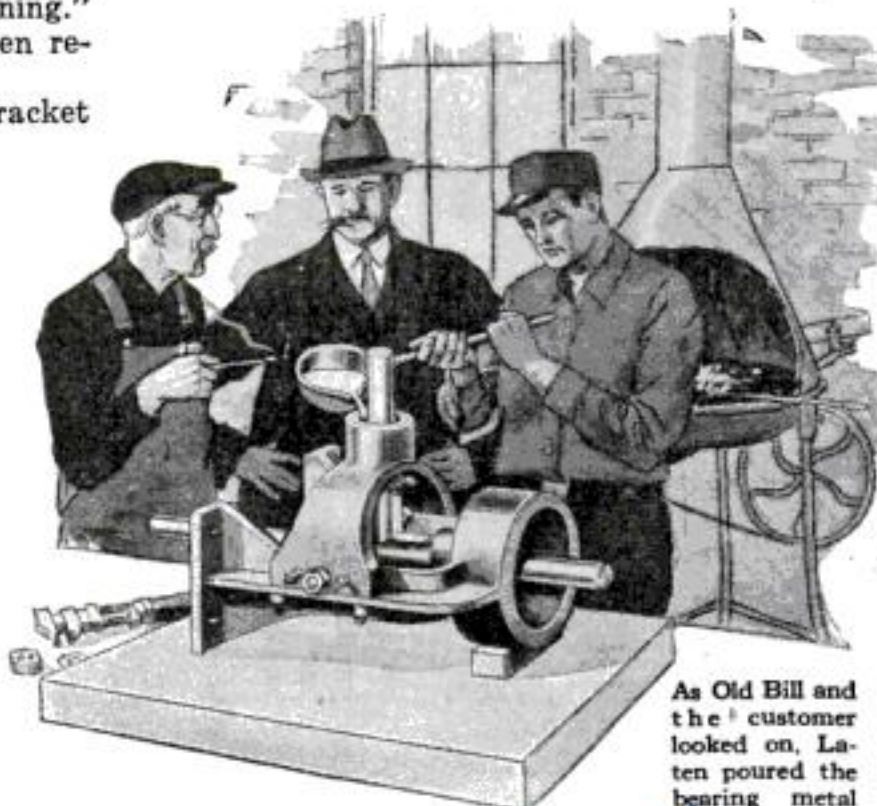
"I suppose you put a shelter over the box and dried it out," the customer said.

"Nothing of the sort," Old Bill replied. "We filled the box full of oil and then poured the babbitt in on top of the oil. The oil floated out, and there was no steam, even though rain was falling."

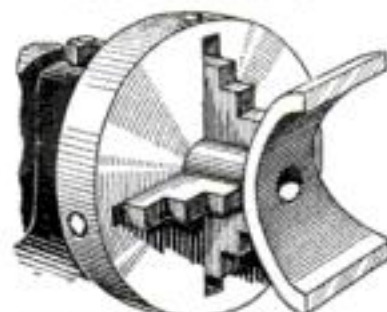
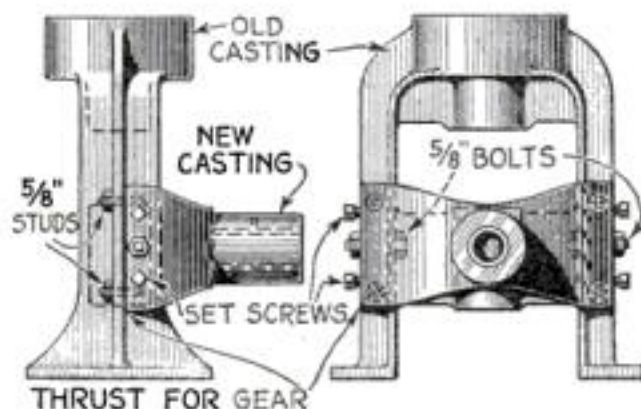
Laten, in pouring the bearing, ran in enough so that he could chip it off flush.

"Send it to me as soon as it is ready," said the customer. Old Bill smiled. He knew the job would be satisfactory.

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 102 to 108.



As Old Bill and the customer looked on, Laten poured the bearing metal



The new casting and old bracket as assembled to form a frame for miter gears, and method of holding the new casting for machining

FACING THE CASTING



Why
Does the Borrower
Always Ask
for
Starrett



Combination Set No. 9

Layout—Checking—General Shop Work—actually, the uses of this splendid kit of tools are limited only by the ingenuity of its owner. Taking up but little room on the bench or in the tool box, the Starrett Combination is a universal favorite with Machinists, Carpenters, Auto-Repairmen and Mechanics of all sorts.

Three attachments: Head, Protractor and Center Head slide freely on the Blade. They can be instantly clamped there in any

position or entirely removed. The Set gives you the use of a Rule, Try Square, Depth Gage, Height Gage, Level and Plumb, Marking Gage (note Scriber held frictionally in Head), Center Head and Protractor. Blade is hardened and graduated in either 64ths, 32nds, 16ths and 8ths or 64ths, 32nds, 16ths and 100ths, as desired. All parts well made and warranted accurate as you'd expect in any Starrett Tool. Sold by good hardware stores everywhere.



Over 25 different sets which can be made up with Starrett Combination Squares and Attachments are described in the Starrett Catalog of 2200 Fine Precision Tools. The Catalog will help you select the Set best suited to the requirements of your work. Mailed free. Ask for No. 23W

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World's Greatest Toolmakers
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The Shipshape Home



*Adjusting cellar sash—
Painting kinks—Chim-
ney repairs—Trousers'
rack—Brace and bits*

Simple Win- dow Adjuster

ADJUSTMENT for window in the cellar, garage, or motorboat, can be provided easily and cheaply as shown below. If the window is hinged at the bottom, a nail is driven into the edge of the sash, and a piece of safety or plumber's



chain is fastened to the frame with a screw. If the sash is hinged at the top, the chain is fastened to a floor beam or to the ceiling above the window. The desired opening is maintained merely by hooking a link of the chain over the nail.—J. F. HARDECKER, Brooklawn, N. J.

Cleaning Paint and Enamel

SHAVE 1 lb. of white soap and melt in 3 qts. of hot water. Add 1 oz. powdered borax, and let the whole simmer, stirring now and then, until the soap and borax are quite dissolved. Wash the painted surface with a flannel cloth with this preparation, cleaning off with clear warm water.

To clean enameled surfaces, first dust off and rub with a soft rag wrung out of hot water and dipped in the finest whiting, or, better still, precipitated chalk, as the latter is less likely to cause scratches.

Your Brace and Bits

KEEPING your home shipshape you find frequent use for brace and bits. If you do not own a brace or have only a cheap one, it will pay you to get a good brace with a ratchet attachment. A wide sweep is not necessary for ordinary work, but the tool should be of the best quality.

Learn to use the ratchet freely; it is a great saver of strength. When well oiled, a slight motion of finger and thumb turns it on to left, right, or off. For corners and all awkward places it is invaluable. For giving the final turn to screws, and for drilling with large bits, it allows you to exert ample strength with the least effort. Indeed, it makes a small brace a very powerful tool. It is well worth practising to throw it on and off.

When much work is done, it is well to

have two braces. One need not be as expensive as the other. The countersink bit is kept in the cheaper one, or, if you are working on hard wood, where two bits are required for making screw holes (one the size of the shank of the screw being used and the other to suit the twist), you avoid constantly having to change bits or drills.—A. E. ELLING.

How to Clean Stained Brick

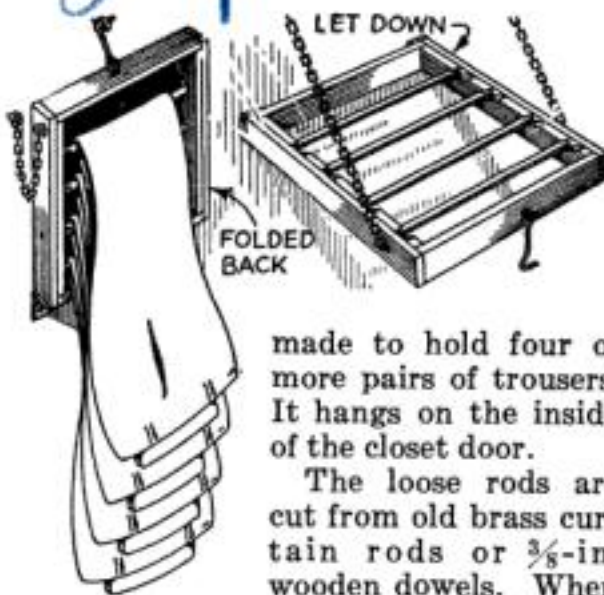
WHEN a brick mantel or chimney place becomes stained with soot or smoke, the discoloration usually can be removed. Take 1 gal. of soft soap, 1 lb. liquid ammonia, and 2 or 3 lbs. finely pulverized pumice-stone. Mix to the consistency of ordinary oil paint and apply to the stain with a fiber brush. In half an hour rub the place well with a fiber scrub brush. The lather made by the process may be removed with water and sponge. It may be necessary to repeat this operation.

Should the trouble persist, it will be necessary to give the brickwork a very thin coat of paint made from Venetian-red ground in oil, thinned with turpentine. If a lighter color is required, add some yellow ochre; if a darker color, add a little blue.—A. ASHMUN KELLY.

Hanger for Trousers

SO SMALL is the usual clothes-closet that it is well named a clothes-press. Any closet space-saving device is, therefore, an aid in keeping a house shipshape.

The trousers hanger illustrated can be



made to hold four or more pairs of trousers. It hangs on the inside of the closet door. The loose rods are cut from old brass curtain rods or $\frac{3}{8}$ -in. wooden dowels. When the hanger frame is "let down," it takes but a moment to slip a rod through the doubled-over legs of a pair of trousers and replace it.—F. S. ROOT, Fall River, Mass.

SLIGHT scratches on window glass, whether common or plate glass, sometimes may be removed with raw cotton charged with jeweler's rouge.

"Helper" for Painting Sash

AFTER her house had been painted recently, a neighbor of mine spent her spare time for a week scraping paint from the margins of the window-panes. Such work is unnecessary. Even an amateur painter can avoid getting paint



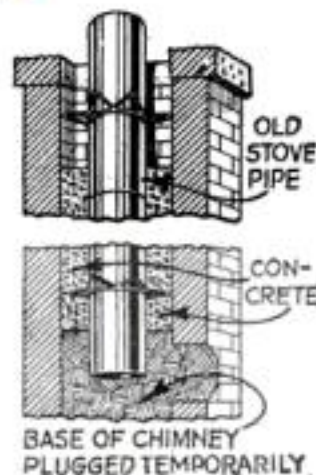
on the window-glass if he uses a painter's tin, or "helper," as it is sometimes called.

The one illustrated is an improvement over the usual tin or cardboard helper, because it is made exactly the size to fit the smallest panes, in this case about 8 by 10 in., and has a handle. The handle is from a discarded coffee-pot.

When painting around panes larger than the helper, it is necessary to shift the tin along, but the handle makes that easy to do and allows the protector to be held so firmly that there is little danger of paint getting underneath the edges and on the glass.—GEORGE T. BROSKI, Northfork, W. Va.

Relining a Chimney

A CRACKED chimney is dangerous and a serious fire hazard. In some cases a repair can be made cheaper and without any skill in masonry work by the method illustrated. Put some old rags or paper in the bottom of the chimney, where the stove-pipe enters, and then connect some old stove-pipes and lower them inside the chimney. Fill in all around with concrete, using a mixture rich in cement. The concrete should pour readily and flow around the pipe without leaving any voids.—OSCAR M. ANDERSON.



The Home Workshop

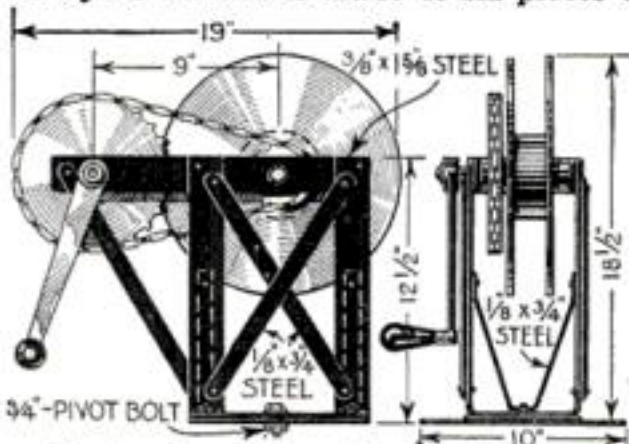
Large Kite-Flying Reel Built from Old Bicycle Parts

By Hugo Ljungquist



OUT of some material from a discarded bicycle, I assembled the kite-flying and game-fishing reel illustrated. The coaster brake was used for the drum on which the line rolls up. The sprocket wheel and chain also were used. The handle is from an old meat grinder.

The ball bearings are of an inexpensive grade. The base, which is collapsible, is 18 by 18 in. and is made of six pieces of



Construction of the reel, which is mounted upon a base as shown in the photograph above

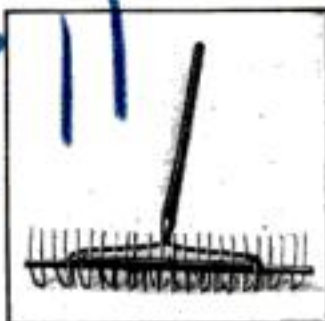
1 by 1 by 1/8 in. angle iron loosely joined with 5/16-in. rivets.

Using this reel, I have flown kites 1 1/4 miles high with perfect control and ease; and when the lure of the sea called, I have gone down to the fishing place and with the same reel landed quite a few big drumfish and other game fish.

Salvaging a Wire Rake

LAWN rakes with wire teeth are some times of such weak construction that the bar holding the teeth breaks from the handle portion.

The accompanying illustration shows a novel and simple way of prolonging the usefulness of such cripples by wiring the bar to a heavy garden rake, thereby making a very satisfactory combined lawn and garden rake. —E. W. CORNELL, Adrian, Mich.



We tried 130 times

Before we perfected this unique Shaving Cream

Now let us send you a 10-day tube to try

GENTLEMEN:

It is only after great effort that great things are done.

We worked for 18 months perfecting Palmolive Shaving Cream. The 130th formula tested was the first to please us.

We knew we had a tough job before us winning men. Most of you were wedded to a favorite preparation. Outstanding superiority was our only chance. We asked 1000 men their supreme desires in a shaving cream. Then set out to meet them.

We've Won

We met those desires—and more. Millions have flocked to Palmolive Shaving Cream. Today it's the leader in its field.

80 per cent of the men who use it were won from other makes.

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60 years of soap study stand behind this unique creation.

It is different—radically, and immeasurably different—from any shaving cream you have ever tried.

5 New Delights

These you'll find—these new shaving joys, these comforts unknown before.

- 1 Multiplies itself in lather 250 times.
- 2 Softens the beard in one minute.
- 3 Maintains its creamy fullness for 10 minutes on the face.
- 4 Strong bubbles hold the hairs erect for cutting.
- 5 The palm and olive oil content leaves the face in fine condition.

10 Shaves Free

Now in justice to yourself, and in courtesy to us, please accept a 10-day tube free. Give us a chance to prove our claims. Find out for yourself whether your present method is not failing in some important ways.

* * *

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with tube of Shaving Cream.

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PALMOLIVE SHAVING CREAM



2910

10 SHAVES FREE and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1041, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill.

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CROSS-CUT SAWS



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It's the Simonds exclusive method of grinding cross-cut saws, coupled with the heat treatment of perfectly tempered Simonds Steel, that produces these easy-cutting, edge-holding, economical saws. Sold by hardware and supply dealers wherever timber is cut.

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The Home Workshop

Are You Making Use of Our Home Workshop Blueprint Service?

Thousands of readers save or earn money by constructing furniture and radio sets

IF YOU wish to make the most of your home workshop and combine the fun you get from working with tools with the production of really valuable, useful, and satisfactory furniture, radio sets and equipment for your house and garden, you should take advantage of POPULAR SCIENCE MONTHLY's series of blueprints. These are what patterns are to the woman who makes her own clothes. They provide at a nominal price the design, style, and methods of construction. They are an insurance against the blunders in design and workmanship that so often detract from the value and usefulness of an amateur mechanic's handiwork.

Many readers of POPULAR SCIENCE MONTHLY now never undertake an elaborate project without a blueprint to guide them. Letters of appreciation come to the Editor from all parts of the world. Here is one from Mr. C. Stentford of Dunedin, New Zealand:

Once again I have the pleasure of addressing myself to you. I should esteem it a favor if you would forward to me the blueprints I have marked on the inclosed coupon, Nos. 17, 24, 26, and 39.

I have had no difficulty in following the methods and details in the blueprints that were sent to me and I think heartiest congratulations are due to you, as well as sincere thanks from all home workers who use the opportunities that you offer them by featuring for their benefit the Home Workshop and Blueprint Departments.

The Editor asks why we read POPULAR SCIENCE MONTHLY. Well, he edits the magazine and should know the class of material he puts into it. It is full of all sorts of kinks, helpful methods of working, interesting articles on all manner of subjects, and any man who cannot find something to interest him in P. S. M. ought to be with his ancestors.

In the February issue, the latest to hand here, you have the details of a Salem chest

(Continued on page 87)

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment. Blueprint Service Dept.

Popular Science Monthly

250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	Title	Published	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat-Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c

Name.....
(Please print)
Street.....
City and State.....



Smoking Cabinet and Workbench

A smoking cabinet (Blueprint No. 2) and a home workshop bench (Blueprint No. 15) are illustrated at the left. Hinged ashtrays are concealed in each end of the smoking cabinet. Four attractive methods of ornamenting and finishing are possible—varnished, painted with a floral design, carved, and inlaid. Both the smoking-stand and the bench are detailed fully in the blueprints

The Home Workshop

Are You Using Our Blueprints?

(Continued from page 86)

of drawers. I have studied the method of construction as portrayed by the drawings and think that that is the simplest way that I have seen in anything of that line. Household furniture, even the plain models, is pretty expensive in this part of the world, and it occurred to me, could other articles of furniture of the box or cabinet style, be built on the Salem plan—a wardrobe, for instance, with single door.

In conclusion, permit me to extend to you my best wishes for the success of your magazine. It is a classic.

Before you start another elaborate project in your home workshop, why not see just what the Blueprint Department has to offer you? Especially to be recommended are the following blueprints:

No. 2—Smoking Cabinet. So popular had this been that the tracing was worn to a rag and the blueprint was withdrawn, but the orders continued to come in and the blueprint had to be re-issued. This is an extraordinarily good woodworking problem for the beginner, because several different ways of making the cabinet are suggested and, while the workmanship is not difficult, the finished piece is equal to some of the most expensive commercial cabinets featured by exclusive Fifth Avenue, New York, tobacconists.

No. 5—Kitchen Cabinet. Contains the details and complete bill of materials for a white enameled or varnished kitchen cabinet of especially attractive appearance. The design includes a self-contained seat, which is rarely found on even expensive commercial cabinets.

No. 15—Home Workshop Bench. Shows how to construct a cabinet type bench of the most substantial kind, with every convenience in the way of cabinets and drawers—a bench that it is a delight to work at, one that any mechanic would be proud to own, and one that will last a lifetime.

No. 41—One-Tube Radio Set. Everyman's radio set. It is exceptionally simple in construction, easy to tune, brings in distant stations with clarity and near-by stations with volume not exceeded by any other type of regenerative receiver. For the man who does not own a radio set, this is an excellent one to start with; for those who already have sets, even multi-tube receivers, this is very apt to be a revelation in efficiency.

No. 42—Three-Stage Amplifier. An audio amplifier designed to give remarkably perfect reproduction of music and voices. It can be added to the one-tube receiver (No. 41) or to any other good detector circuit. Radio fans who are accustomed to the average two-stage amplifier will be amazed at the quality of this resistance-coupled amplifier.

No. 43—Four-Tube Radio Receiver. For its superfine quality, it is one of the lowest priced sets a radio fan can build. It has been tested and approved by the Institute of Standards.

If you wish one or more of these blueprints, fill out the coupon on page 86 and mail it at once to the Blueprint Service Department.

From all over the world they come to **BROWN & SHARPE** for Tools—

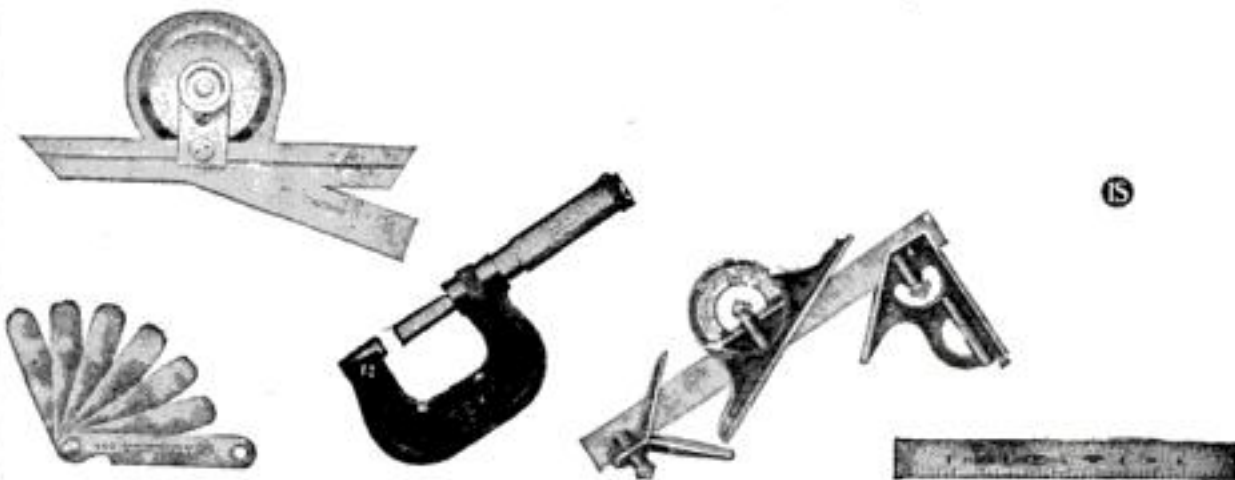
In every nation men who work with metal look to Brown & Sharpe when they need tools for exacting work. They know the reliable accuracy and convenience of design of Brown & Sharpe Tools—accuracy and convenience proved on the job every day. And so, from all over the world, they come to Brown & Sharpe for tools.



Whether he is a garage man in London, a machinist in Turin, a Russian mechanic or a French mechanic, he reads a Brown & Sharpe micrometer and knows he is *right*. In every language, "Brown & Sharpe" means "tool superiority".

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TOOLS

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Turn cap, at bottom of "Yankee" Push Drill, to get exact tension for every job.

Seven Adjustable Tensions *at the turn of the cap*

Want to bore a 1/16 hole in brittle wood? Turn cap on handle to left and get an easy, light tension.

Next you may need to drive a 5/32 drill into rough timber. That needs a powerful tension. You can get it by turning cap to the right.

"YANKEE" Automatic Push Drill No. 44

The only push drill that can be regulated to suit each job. Saves time, effort and drills. Eight drill points, 1/16 in. to 11/64 in. held in magazine in handle. "Yankee" No. 44, without adjustable tension, for those who do not need this feature.

Some other "YANKEE" Tools
Ratchet Bit Brace
Spiral Screw-drivers
Ratchet Hand Drills
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Dealers everywhere sell
"Yankee" Tools

"Yankee," on the tool you buy means the utmost in quality, efficiency and durability.

FREE to those who love good tools



The "Yankee" Tool Book delights every tool lover. Write for a copy of this Free Tool Book

The Home Workshop

Ten-Cent Measuring Tape Used in Making a Magic Card "Pull"

By Kenneth B. Murray

ONE of the professional stunts exhibited by the amateur or professional magician is that of causing an unprepared playing-card to rise from one hand to another 12 in. or more above. The trick can be duplicated readily by making what magicians call a "pull," as shown below.



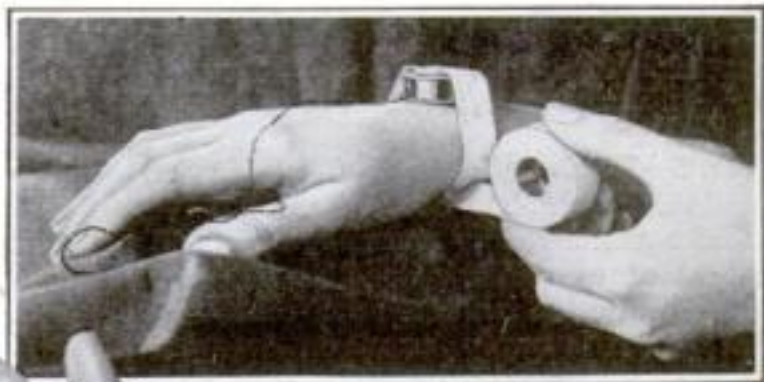
Purchase a small spring measuring-tape for 10 cents and after unwinding it, cut off all but an inch or two. Tie a fine black silk thread to the stub of the tape



When as much thread as possible is wound up, cut it off near the case and tie a small button firmly on the end



The button must be treated so that it will stick to a playing-card. This is accomplished by smearing one side with common beeswax



A strip of surgical adhesive tape is used to fasten the measuring-tape box on the back of the wrist. Care must be taken to place it sufficiently far back so that the coat-sleeve will conceal it completely



In presenting the effect, hold the prepared button between the first and second fingers and take care to stand against a black background. Allow the cards to be examined if you wish. The button then is pressed against the top card of the pack, which is held in the left hand. When the card is released, it floats gracefully to the right hand because of the pull exerted on the black thread by the spring in the tape-measure case



NORTH BROS. MFG. CO., Philadelphia, U.S.A.

"YANKEE" TOOLS

Make Better Mechanics

SCHEDULED for early publication are the following articles: How to Fit Up an Attic Room, Repairing an Electric Iron, Simple Pocket-Knife Carving, A Unique Doll Boxing Game, How to Apply Polychrome Finishes, A Spiral-Leg Davenport End Table, Relining

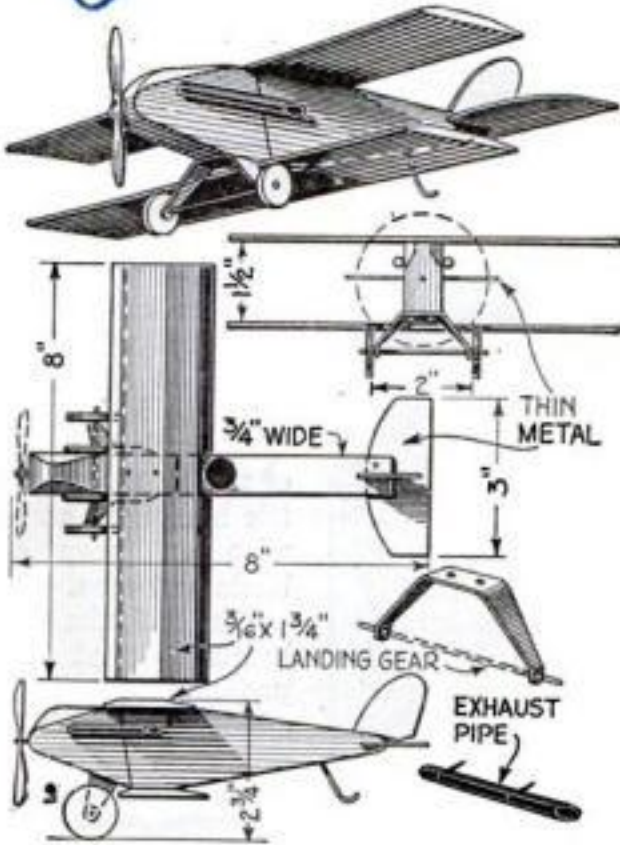
Automobile Clutches, How to Make an End Lap Joint, A Workshop Nail Cabinet, Homemade Jigsaw, Constructing and Finishing a Two-Tone Radio Cabinet, Novel Mats and Baskets Made from Corn Husks, A Ball-Bearing Drill, and a Photograph-Print Washer.

The Home Workshop

Toy Model of Racing Airplane Whittled from Soft Wood

WHETHER or not you have whittled the toy airplanes described in the June and July issues of POPULAR SCIENCE MONTHLY, you will find the racer model illustrated below easy to make and at the same time a realistic and fascinating toy. This model, when neatly painted, amuses the children better than the flimsy tin airplane toys that are now so common, and is far more durable.

The body is whittled from a piece of soft pine or other wood $\frac{3}{4}$ by $1\frac{1}{2}$ by 7 in. The wings, which are $\frac{3}{16}$ by 8 in., are fastened to the body with brads and glue. The landing gear consists of two wooden



Whatever dimensions are not given in these drawings can be estimated closely enough by eye

wheels $\frac{3}{16}$ in. thick and 1 in. in diameter, mounted on a wire axle, as illustrated.

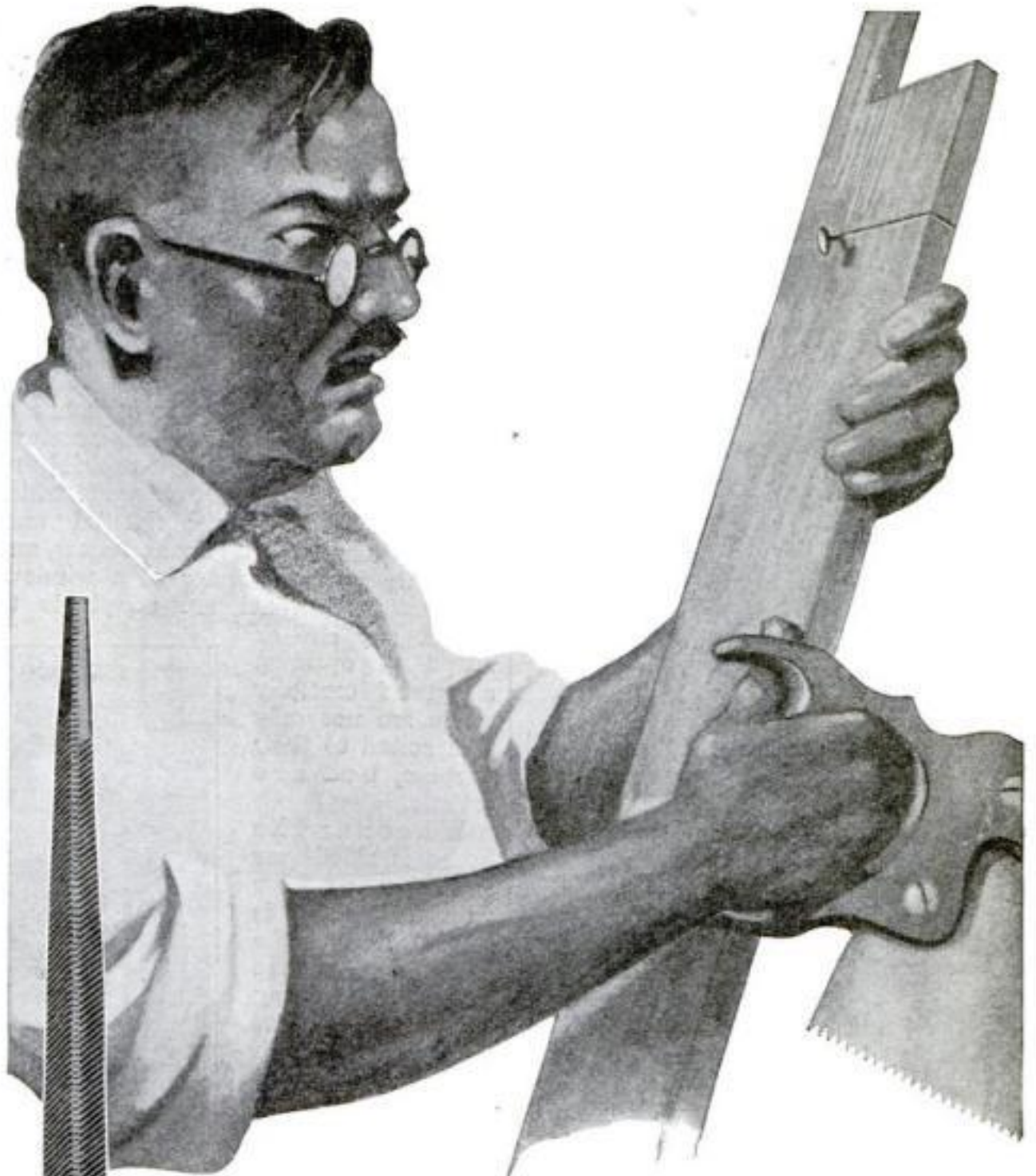
The tail members are cut from thin sheet metal and inserted in slots in the body. Brads are used to make the fastenings secure. The propeller also is thin metal mounted on a brad or escutcheon pin driven into the nose of the body. A glass bead serves as a spacer between the wood and the propeller. The exhaust pipes are cut from a $\frac{3}{16}$ -in. wooden dowel.

The body should be painted dark blue and the wings gray. The cockpit may be merely a circle painted black or a shallow hole bored into the top of the body, just behind the trailing edge of the upper wing.

The fourth toy in this series will be an express cruiser.—D. W. C.

Sliding Clothespin Bag

HANGING out the family wash on a clothesline of the yard type—one that has no pulleys—is made easier by the use of a sliding clothespin bag like that illustrated. The bag is fastened to a wire frame.—I. E. HOUK.



Saws are blind as bats!

OCCASIONALLY they will strike a snag that even you cannot see, working havoc with their finely tempered teeth.

But a good saw has amazing recuperative powers—especially when “treated” promptly with the right NICHOLSON File.

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—a File for Every Purpose

The Home Workshop

How to Build a Ventilator Louver Type of Opening Simple to Install in a Frame House or Garage

By Edwin M. Love

ROOF ventilators, either through damage or desire for a change of design, occasionally need replacement. For the frame house there is probably no better type than the louver vent, which consists of a number of horizontal vanes inclined so as to shed rain and snow, and cased up in the manner of a window-frame. Such vents are adaptable to almost any size or shape of opening, and if carefully made are not only well suited to their purpose, but are artistic.

Whether the house is sided-over sheathing, or the weatherboarding is nailed direct to the studding, matters little in the building of the ventilator. The outside width of the frame should be at least 1 in. narrower than the distance between the side trimmers of the opening, to allow for wedging and plumbing, while the height must be such that it easily will clear the trimming headers.

Use 1 by 5 in. stock for the jambs. Joint and surface the two at one time, as a pair, and lay out both for dados to receive the ends of the vanes as follows: At the bottom, a groove $1\frac{1}{2}$ in. wide, and at 3-in. intervals, measuring top to top, grooves $\frac{3}{4}$ in. wide, all inclined at an angle of 60 deg. with the edges. Gage these for a depth of $\frac{3}{8}$ in., saw the sides by cutting in the waste wood, and remove the chips with a chisel. Some workmen merely butt the ends of the vanes to the jambs, but the vent is much more difficult to assemble and the construction is decidedly poor.

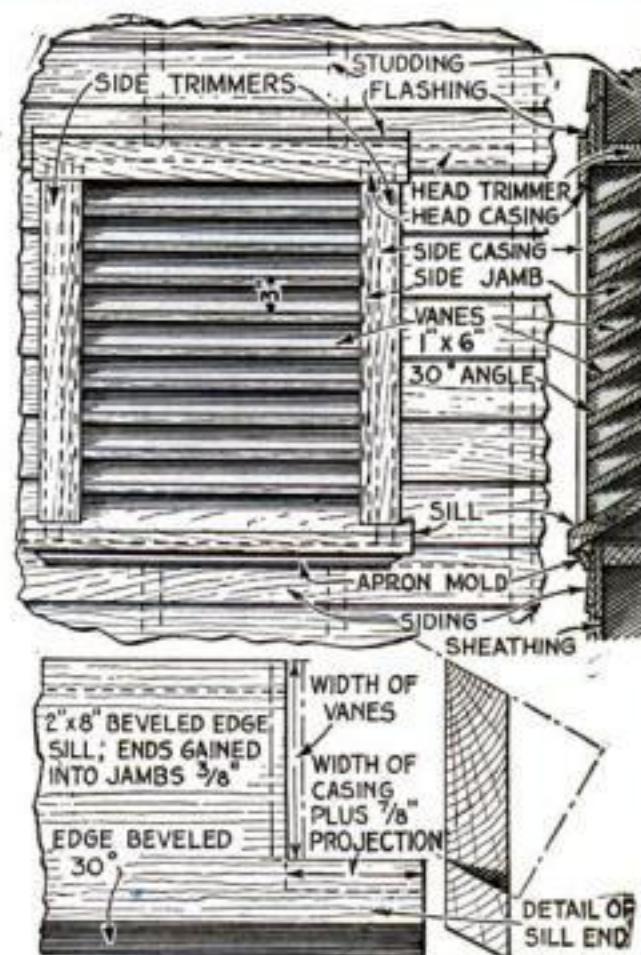
Cut all the vanes of 1 by 6 in. pine $\frac{3}{4}$ in. longer than the inside width of the ventilator. The 2 by 8 in. sill is beveled on the edges to correspond with the slope and is notched from the back at both ends to the width of the jambs as measured along the dado. The main length of the sill therefore is equal to that of the vanes. Leave the projections or "horns" 5 in. long. Assemble all the vanes and one end of the sill with one jamb and then nail on the other jamb. If the parts are oiled or primed before assembly, the job will be so much the better. Plane the projecting edges of the vanes to align with the jamb edges.

Use 1 by 4 in. clear stock for the casings. Cut the head casing 10 in.

longer than the inside width of the vent, and nail in place with the lower edge 3 in. above the lower edge of the top vane. Square the assembly, and cut in the side casings.

An easy way to get the length of a side casing is to cut the bevel on the lower end, lay the vent on its back, and lay the casing upside down in place with the point against the sill and blocked up from the jamb $\frac{3}{4}$ in., and mark the upper end by the head casing. Cut a trifle long so that the joints will be forced tightly together when the casing is nailed on. Put the inside edge flush with the face of the jamb. Cover the back with screen wire to keep out birds and flies.

Cut off the sill horns so that they project beyond the edge of each casing, a distance equal to the



Front view and end section of a rectangular louver vent, and details showing end of sill

projection in front, or about 1 in. Give the same amount of projection on the head casing as is shown on the head casings of the house windows.

In setting, slip the ventilator into

(Continued on page 91)



Buyers of good tools, the kind of tools that give husky, long-lived service, will want V & B Vanadium Hammers and V & B Unbreakable Planes for their kits.

They're two thoroughbreds that will give you years of service.



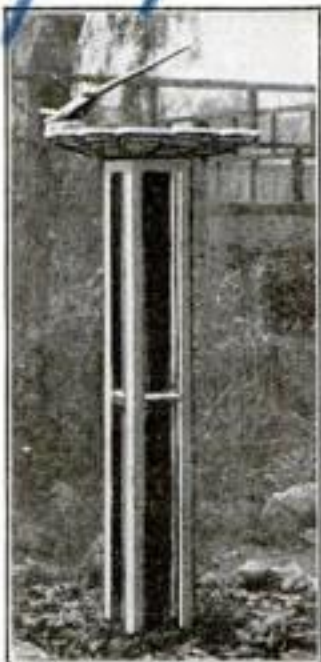
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The Home Workshop

Birds' Bath and Sun-Dial Made Entirely of Wood

NO GARDEN is complete without some provision for the birds. Bird lovers may combine a birds' bath and a sun-dial with pleasing effect, and thus earn the lasting gratitude of their little feathered friends.

The center column of the stand illustrated (2 by 3 in.) and the four rough slats surrounding it ($\frac{1}{2}$ by 1 in.) extend 4 ft. above ground. The basin nailed at the top is made from two circular pieces, each 2 ft. in diameter and 1 in. thick, one glued on top of the other. The top piece is like a doughnut with the large center removed, leaving only a 3-in. rim or edge on which the figures for the sun-dial of the twelve hours are carved or even painted, as your taste dictates.



Both bird and bath are carved

The shadow is cast by the extended bill of a carved wooden bird perched on the rim. The under side of the plate or bowl may be carved to represent a large sea-shell.—A. MAY HOLADAY.

Tin Strip Safeguards Contents of Tightly Packed Drawer

TO PREVENT objects in a drawer from catching when the drawer is pulled out, I fasten a piece of tin to the upper drawer rail as shown. The tin is about 5 in. wide and not quite as long as the drawer.



BENT-UP TIN
NEARLY AS LONG AS
WIDTH OF DRAWER

The inside edge of the drawer is planed down so it will not rub against the tin, which is invisible when the drawer is shut.—ARTHUR FLINER, Wichita, Kans.

Building a Ventilator

(Continued from page 90)

place from the outside, plumb the jambs, and nail through the casings and head into the side trimmers, afterward wedging the sides and sill tightly. Lastly, put underneath the sill an apron made of 3-in. bed molding with a return mitered on each end.

If it is desired to have the siding boards butt against the casings, set the vent without casing and fit the casings one by one to the ends of the boards. Or, if it is new work and the siding is not yet on, first build the ventilator complete and fit the boards to the casings after it is finished.



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TRADE MARK
TRANSFORMER
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The Home Workshop

Sturdy Swinging Cut-Off Saw Frame Made of Pipe and Fittings

By Frank N. Coakley

Def. 4x2 for 12

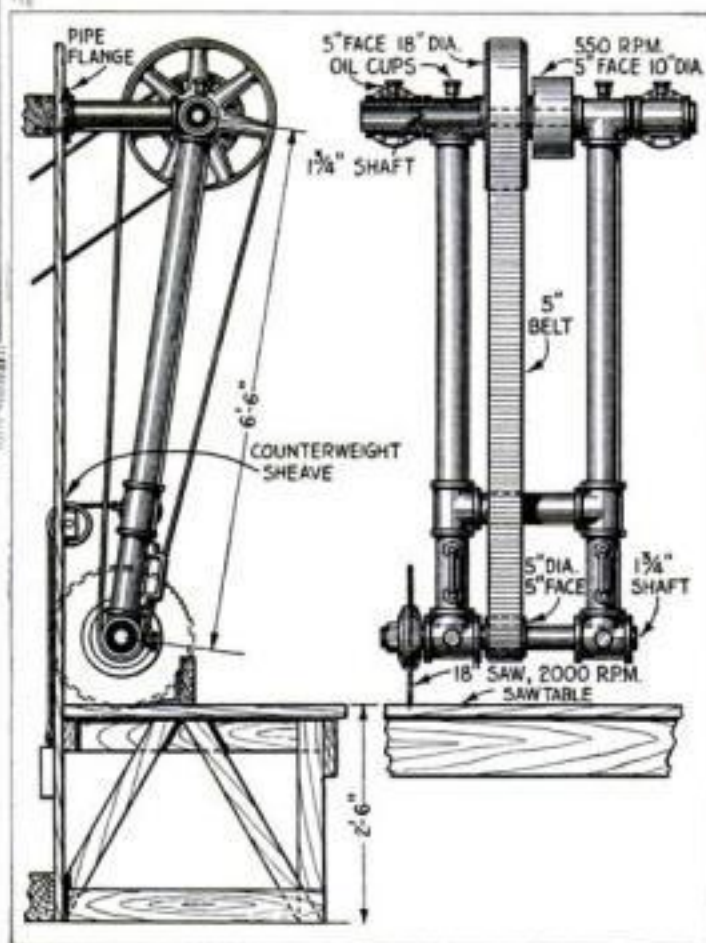
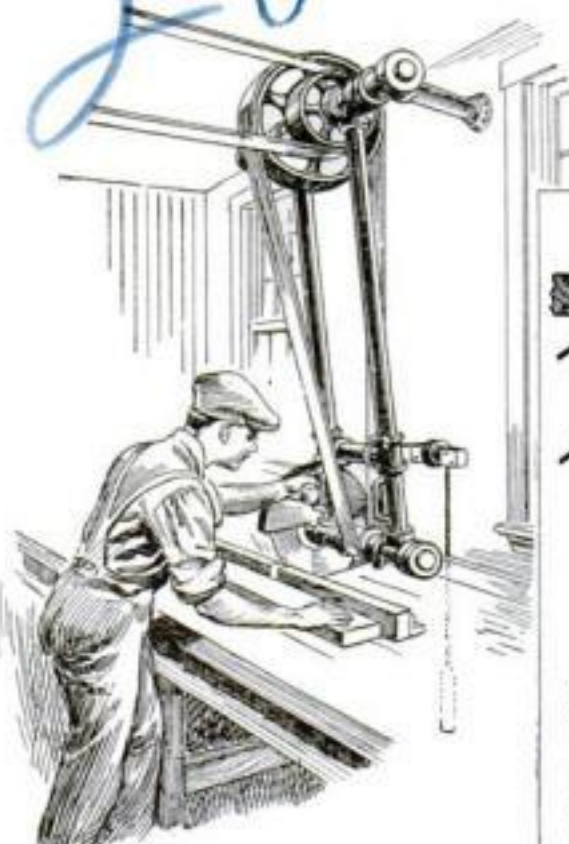
WHENEVER long boards or timbers have to be cut to length in any quantity, a swing-saw is almost indispensable. The owner of a small wood-working shop, the farmer who does much construction work, the small building contractor, and the pattern-maker can build the frame for such a saw at relatively small cost for material by following the design illustrated.

This is not only a cheap saw to make, but is also a sturdy machine and one that with proper handling should last for years. The material from which it is constructed is standard and there

bearings. This is especially necessary for the saw mandrel.

For the saw mandrel another piece of 1 3/4-in. cold-rolled steel is used. The saw end is turned down to 1 1/2-in. diameter and a left-hand thread cut for a 1 1/2-in. nut. This shoulder acts to back up the saw washers, which should be about 1 in. in diameter, 5/8 or 3/4 in. thick, beveled as shown. The pulley on the mandrel is 5 in. in diameter with a 5-in. face, securely keyed to shaft, which runs about 2000 r.p.m.

The frame itself is made of lengths of pipe. While 6 ft. 6 in. is called for, 6 ft. would work out satisfactorily, but anything shorter would give too short a belt for driving at the speed mentioned. A cross brace is provided to prevent any weaving action in the frame. All the



This swing saw, which is designed for the small shop, can be built without expensive machine work

should be no trouble in purchasing it, even in small towns.

While no sizes are given for the various fittings, I do not advise the use of anything smaller than 2 1/2-in. pipe for this size saw. However, if one were to build a frame for a 12-in. saw, 2-in. pipe would be heavy enough.

The frame is hung from two brackets of pipe that are fastened to the side wall with two standard flanges. The tees on the brackets are machined to allow the end pieces of the swinging frame to pass through. The top and bottom tees of the frame are babbitted to form the bearings for the countershaft and the saw mandrel.

The countershaft is a piece of 1 3/4-in. cold-rolled steel, having a keyway for a 3/8-in. square key. The small or driven pulley is 10 in. in diameter with a 5-in. face; the driving pulley is 18 in. in diameter and 5-in. face.

The countershaft is to be run at 550 r.p.m. At this juncture, care must be taken to provide oil or grease cups and to be sure that the lubricant gets into the

joints must be perfectly tight, as the machine may receive more or less abuse.

Two handles are fastened, one to each frame, for pulling the saw through the wood. This operation can be done just as well with a foot lever carried up in back of frame and fastened to the bottom tee with a link. To pull the saw away from the wood, a counterweight is used. While some prefer springs, the counterweight is always dependable.

The table may be made from any lumber that happens to be handy. The back board can be made a sliding affair, if desired, steel angles supporting and holding it to the table.

It is essential, of course, to provide some kind of a guard for the saw.



Home Workshop Chemistry

*Simple Formulas that
Will Save Time
and Money*

FOR posts placed into the ground, the best preservative is creosote. This can be applied by boring a small slanting hole in the base of the post just above the ground and filling the cavity formed with this liquid. The hole then is stoppered with a small plug. Three or four days later more creosote is added and the hole again plugged. At the end of a week a final addition is made and the plug permanently fastened in place.

Wood that has been darkened can be bleached, as well as naturally dark lumber such as walnut. Ordinary bleaching powder, which also is known as chloride of lime, is mixed with water to form a thin paste. This is applied to the wood and allowed to dry. The dry paste then is moistened with diluted hydrochloric acid made by adding one part of the acid

Applying a
bleaching
paste to
dark wood



Mixing dry
chloride of
lime with
diluted hydro-
chloric acid

to three times the volume of water. After a few hours, clean the wood. If it is not sufficiently bleached, repeat the process.

Certain precautions are necessary when two pieces of wood are to be joined by glue. Carpenter's glue should be broken into fine pieces and soaked in cold water. Never add hot water as it will prevent the glue from swelling throughout its entire mass; just the outer layer will dissolve. Use just sufficient cold water to cover the glue. After all particles of glue have sunk to the bottom or stuck to the side of the vessel, a little more water is added so that all the glue is submerged.

After soaking about 10 hours, the glue is heated to just below the boiling point—so that it will melt. Never boil the glue; joints made with boiled glue never will be as strong as those joints united with glue that has been heated just enough to make the jelly fluid.

Glue, when it hardens, becomes brittle, and since flexible glues are required for certain types of work, such as regluing the bindings of books, glycerine is added to the glue. The quantity of glycerine added after the glue has been melted in the ordinary way usually is equal to the weight of the dry glue used. The glycerine is stirred in after the glue has been liquefied.

???



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The Home Workshop

Hooded Cab for Model Locomotive

Sixth Article on Building a Miniature Railway

BROADLY By Edward E. de Lancey

speaking there are two types of cab for an electric locomotive—the car body type and the central type with hooded ends. The former was illustrated so fully in the fourth article of this series (June issue, page 86) that nothing further need be said about it.

The hooded-end locomotive illustrated is not, strictly speaking, a model for a true model must reproduce not only all essential details, but must be made accurately to scale. This does neither, but its defects are such that only a person familiar with its New York Central prototype would be likely to detect them.

You may start with a built-up under body similar to that in the fourth article. In this case, however, you must omit the heavy bumper beams needed for the car-type of body. Substitute light end pieces as illustrated below. Do not forget the little slots near the left-hand side of each end. These are for the uncoupling levers to be described later.

Another variation from the basic construction previously described is in the location of the reversing and control switches, as the cab is smaller and has windows in different positions.

The central cab is 8 in. long, 5½ in. wide, and 4 in. high. The outside surface of its sides should come precisely flush with the outside of the under-body sills.

The ½ by ⅝ in. molding strip over the sills should be omitted in this locomotive.

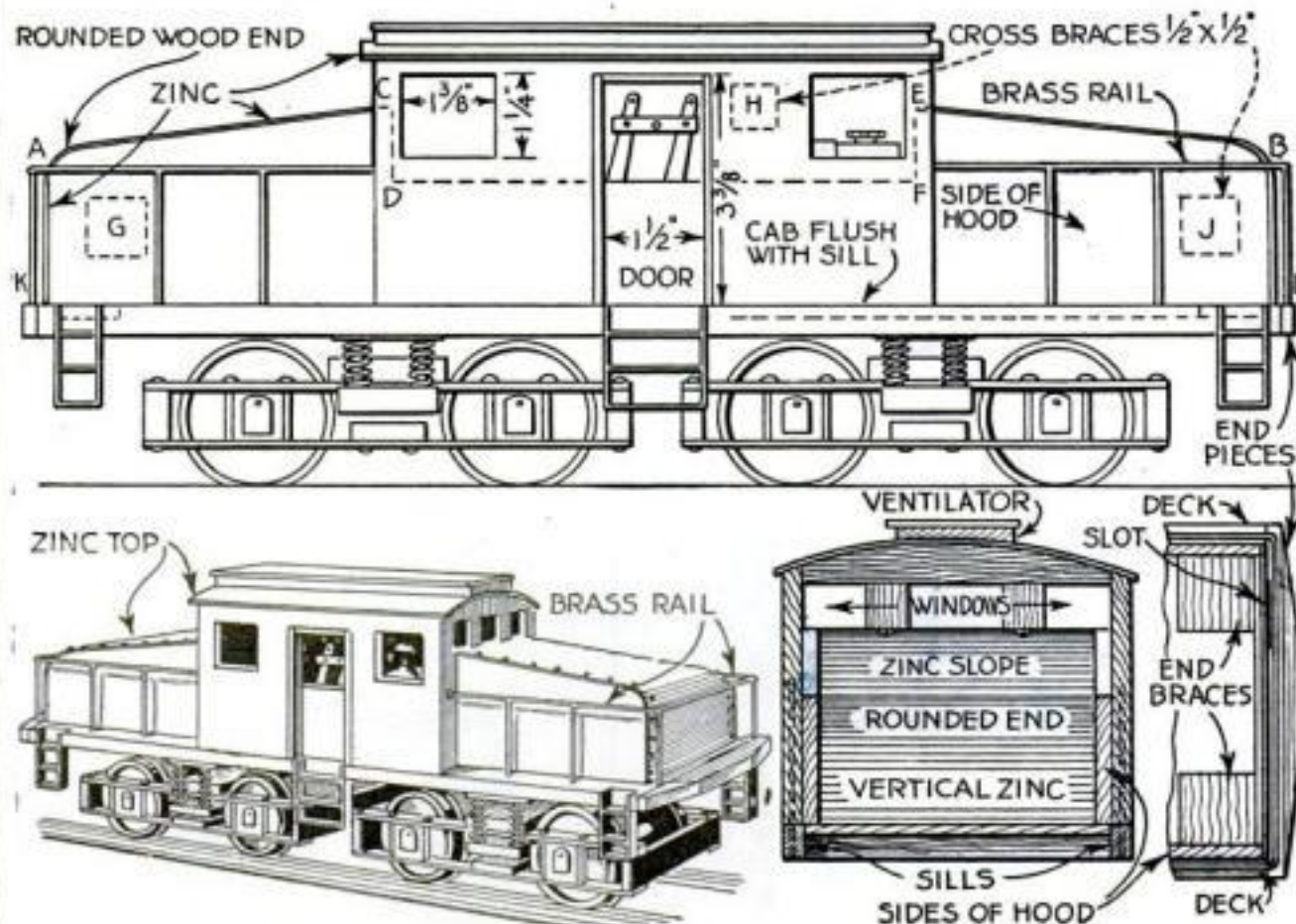
The best material for the cab and hoods is light cigar-box stock, approximately ¼ in. thick. It must be straight grained, dry and free from warp. For the sides of the cab, select two such pieces, 8 in. long by 3½ in. wide. Fasten these together temporarily with light brads or pins, and see that all edges are square and match exactly. The two outside surfaces of these pieces will be those of the finished cab, therefore, in anticipation of future painting, give them a smooth, dry finish with sandpaper. Mark out the windows and doors as shown and cut them with a fret- or coping-saw, after drilling a small hole at diagonally opposite corners of each space for an opening



to allow the insertion of the saw blade.

As the superstructure is to be a single continuous structure from end to end, both sides of each hood are continuous from A to B. These, when finished, will pass inside of the cab walls, as shown by the dotted line C-D-E-F. Beyond the main cab ends, the hood walls will leave a narrow strip exposed to represent the wider deck of a real locomotive, as marked on the partial plan view. These two pieces will range from 2 to 2¾ in. high and will be 17½ in. long. Fasten them together and saw as in the case of the two sides of the cab. Fasten the hood sides firmly with small, sharp head-

(Continued on page 95)



Side elevation and sketch (accessories omitted) of a model locomotive with hooded ends; cross section through the cab looking toward inside of hood, and plan view of one end of hood

The Home Workshop

Cab for Model Locomotive

(Continued from page 94)

less pins to the inside of the cab sides.

Be certain that the two pairs of sides are exactly equal in length, that the cab is precisely in the middle, and that each pair is at the proper distance from the ends of the under body. Block them firmly in this position, and see that the outer surfaces of the cab sides are truly flush with the outer edge of each body sill. Now cut three $\frac{1}{2}$ by $\frac{1}{2}$ in. cross braces of such length that each will fit exactly between the inside edges of the two pairs of sides.

The positions of these cross braces will probably interfere least with the controller and reverse switches if they are placed near each end and near the middle. The dotted squares G, H, and J show good locations. Fasten them to their adjacent cab, or hood, sides by means of fine round-headed brass brads.

THE covers over the hooded ends may be made of sheet zinc, as that metal is pliable and easily handled. Cut two sheets of such width as just to cover the distance between the outer edges of the hoods, and make them long enough to reach, with all bends included, from K to C, and from L to E. If they should be a trifle too wide, in spots, it is an easy matter to true them up with a fine flat file after they have been fastened in place. In the matter of length, $7\frac{1}{4}$ in. will be correct enough to enable you to trim off any excess that may prove to be unnecessary.

Make them accurately square at all corners, and see that the top ends fit closely between the cab corners at C and E. Remember that the zinc extends about $\frac{1}{4}$ in. into the cab at this point and is level under the three end windows. This level stretch is to support the window spacers. Do not overlook the two extremely fine wood screws by which the spacers are secured. They are placed 1 in. each side of the center line.

When both zinc covers have been brought to a good fit, scratch a straight line along each side, so that it comes exactly over the middle of the thickness of the sides of the hoods. Now drill a series of small holes along this line, just large enough to admit very fine round-headed brass brads. Space these holes not less than $\frac{1}{2}$ in. apart, else you will be liable to split the wood.

Your superstructure now virtually is complete. Couplings, steps, hand rails, and ventilators will be left until the next installment.

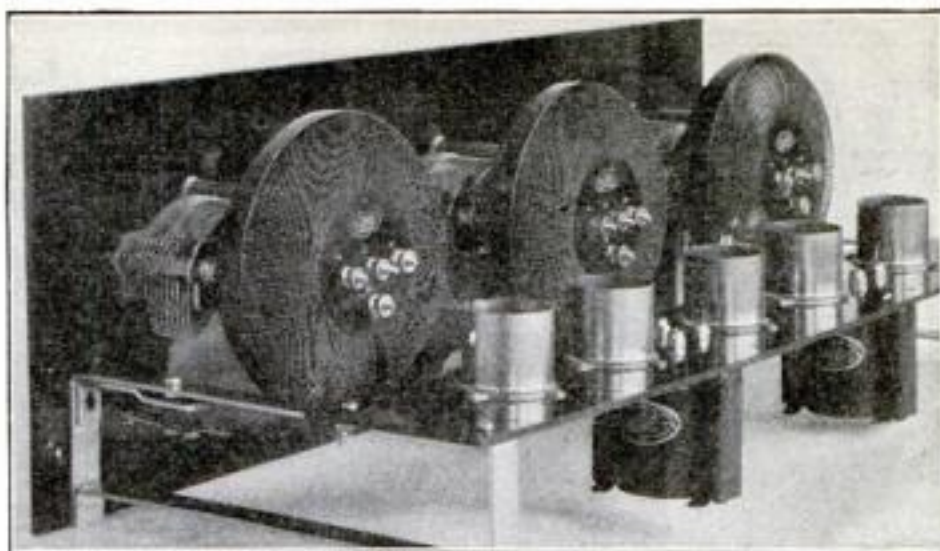
Heavy Duty Clothespins

CLOTHESPINS

For blankets, rugs, and other heavy fabrics, may be made as shown. First place the narrower slot over the material; then pull the pin around and fasten it.



A novel clothespin



Amazing new receiver

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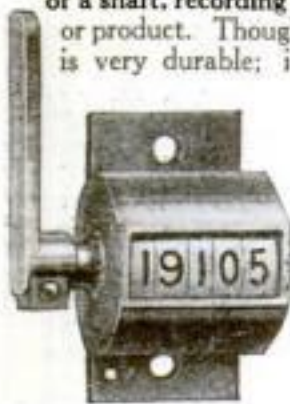
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\$2.00. (Cut 4-5 size.) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also \$2.00.

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up. A spring clutch controls the recording mechanism.



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The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

The Home Workshop

Quickly Made Holder for Door Work

WHENEVER you have doors to hang or refit, you will find it saves time to nail together a door-holder like that illustrated. It grips a door firmly while it is being planed and mortised for the hinges.

A piece 1 by 4 in. by 2 ft. long, not too stiff, is nailed at each end to "two by fours," as shown. Two pieces of joist ends about 12 in. long are cut on the bevel and nailed from underneath to the 1 by 4 in. board. A little experience will show you how much space is needed between them. I find that 1/2-in. clearance is all that is necessary—2 1/4 in. for doors 1 3/4 in. thick. The weight of the door bends the 1 by 4 in. piece and causes the joist ends to grip the door securely. On lifting up the door, it is released at once.

When planing a door, carpenters often cut a board between the door jambs and make a notch in it to receive the door, but



that method scratches the woodwork and blocks the doorway and therefore is not as good as using a holder.—R. M. REKERT, Regina, Sask., Can.

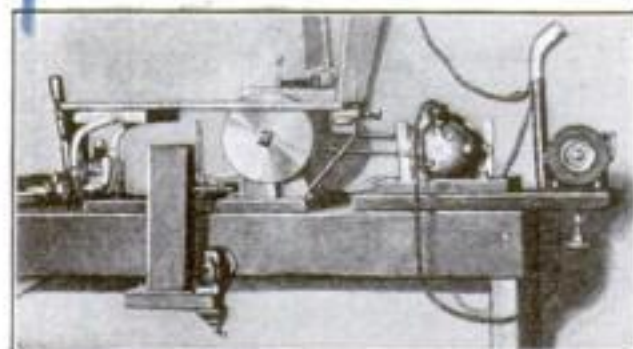
Vacuum-Cleaner Motor Runs Small Machines

By O. H. Lovejoy

MY HOME "machine-shop" was constructed from an old vacuum cleaner, curtain rods, and oak pieces. The motor operates successfully a circular saw, a small lathe, and a carbide wheel, caring for all home jobs.

The motor is anchored to a block with two iron strips drilled to fit and attached by the thumb-screws of the old dust bag. The switch in the end of the cleaner is fastened to the end of the bench to be accessible for all work. A tin-can lid, perforated and bolted tight against the stone, serves as a pulley wheel for belting the grinder to the motor.

The mandrel is a piece of old curtain rod 3/8 in. in diameter, set in an upright



The machine as set up for sawing. Only the saw and the leather belting were purchased

of the blade are the square nuts on the lower end of radiator bolts of a Ford car.

The platform of the saw is a piece of 1/2 in. soft pine pivoted between the prongs of the old cleaner handle. The saw was allowed to cut its own groove in its table, which is lowered and elevated by a thumb-screw of an old bolt working against a vertical piece of steel screwed to the base.

The lathe, which is shown turning out a vermilion wood tray, is obtained by fastening a small iron plate with a nut on the mandrel. Two screws

pass through the plate into the back of the block to be turned. The rest for the turning tool is merely a "T" of two oak pieces fastening to the front of the bench by a small vise. The turning tools are small files shaped at the end.

The motor block is slotted, so that the two long motor screws may be adjusted to tighten the belt. The mandrel block is really two blocks interlocked at right angles and fastened to a stationary base.

It is surprising what clean work the device turns out and how really powerful the little motor proves. The only money spent in setting it up was for the circular saw blade and a length of sewing-machine belting.



The mandrel, with faceplate attached, being used for turning a tray of vermilion wood

oak block, with a bushing made of a hollow curtain rod. This bushing is fitted into a hole bored through the block. The pulley on the mandrel is one of the wheels of the old cleaner with a groove sawed to take a belt of the sewing-machine variety.

As the saw had too large a bore, an ordinary iron washer was fitted into the hole. The retaining plates on either side

EVERY home worker will find helpful suggestions in a series of articles, "How to Fit Up an Unfinished Attic," the first of which will appear next month. The series will be a veritable textbook on house woodwork.

The Home Workshop

"Hard Edge" Upholstering

(Continued from page 76)

stitching through not to catch any of the coils of the springs. Make two complete rows around the edge of the top surface and take a few stitches through the center.

To produce the so-called "hard edge," first remove the tacks holding the burlap, and carefully retack along all four rails. Keep about $\frac{1}{2}$ in. from the top edge. Draw the burlap down smoothly so that the edge remains even. Work from the center toward the legs and at the corners remove any surplus burlap, fold the edge under, and tack close to the legs.

Use a 6-in. curved needle with stitching twine and take several rows of stitches, as shown in Fig. 6. Begin at the left-hand end of one of the rolls by inserting the needle into the edge at a point from 1 to $1\frac{1}{2}$ in. above the row of tacks. Let it come out at about the same distance from the outside row of top stitching that was put in previously. Insert the needle again about 2 in. to the right of this and about $\frac{3}{4}$ in. from the row of stitching and allow it to emerge about even with the top of the rail.

INSERT the needle again at a point about 2 in. from where it came out and on a line with your first stitch; then pass up at a distance that will bring it on a line with your first top surface stitch. Continue in this zigzag manner until you have gone around the four sides. It might be well to try several stitches first before drawing your twine up to shape.

The object of this stitching is to draw the stuffing out toward the side so as to maintain an even edge and hold it there by the stitches that pass through it. When a complete row has been made, a second and a third may be done.

During the making of the rolled edge it will be necessary to "regulate" as you go along; by this is meant, drawing enough of the stuffing up to the sides so as to fill out any irregularities that may occur in the roll. This is accomplished by means of the stuffing regulator, or your needle may be used. Force it through the burlap at the point where you wish to fill out the edge and scrape and pull enough of the stuffing to the edge to give the desired shape when the twine is drawn up.

The second and third rows of stitching are made with shorter stitches and are not in the zigzag manner, but merely pass through the corners. The needle always is inserted at right angles to the edge, as this helps draw the stuffing into the roll.

The center now is filled up evenly with moss, tow, curled hair, or kapok and a piece of sheet wadding or several layers of cotton batting are placed on top of this. The whole then is covered with muslin, as in Fig. 7. The corners are folded in carefully and the edges tacked close to the rabbet in the rail.

The final cover is put on as illustrated in Fig. 1. Soft material, such as cretonne, velour, or corduroy, should be used in preference to leather.

A piece of black cambric usually is tacked over the bottom along the rails.



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The Home Workshop

Simple Method of Making Inlays for Your Homemade Furniture

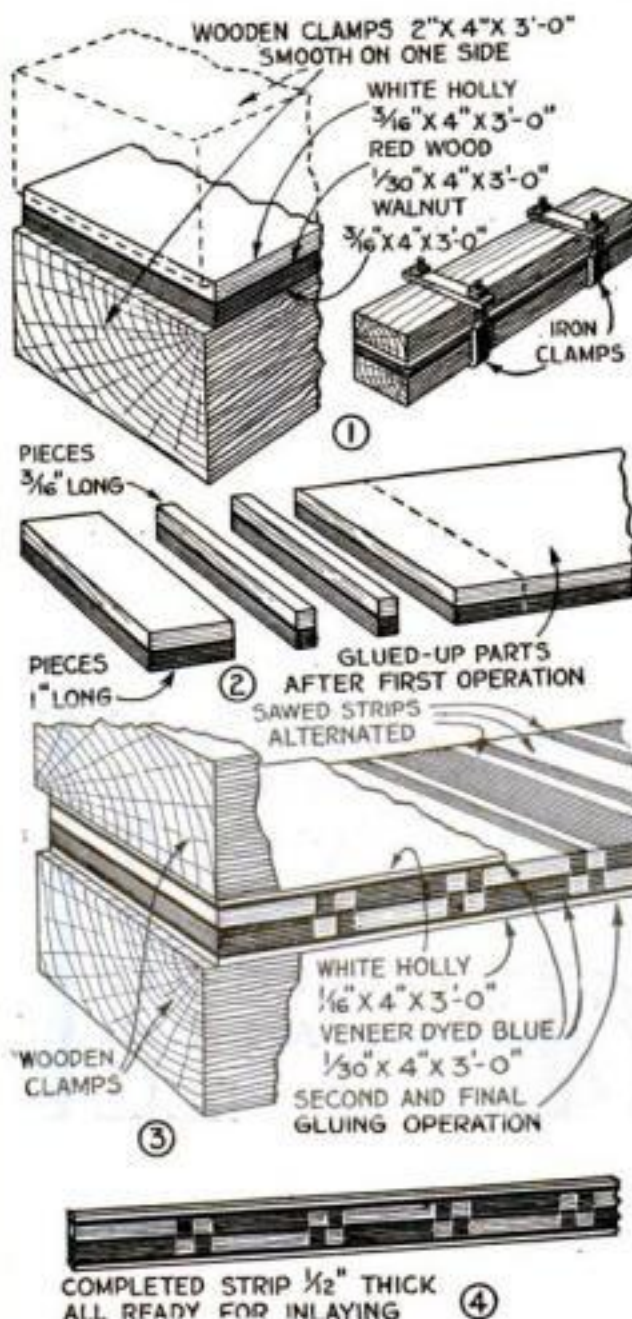
By William Rodgers

WHEN you have a radio cabinet, smoking-stand, small table, or any other simple piece of furniture to build, why not try your hand at ornamenting it with inlays?

Contrary to the belief of most amateur woodworkers, inlays can be purchased quite cheaply and applied easily. If you do not know where to purchase inlays, send a stamped, self-addressed envelope to the Information Department of POPULAR SCIENCE MONTHLY, which will furnish you with a list of dealers, or, better still, because more interesting, make your own inlays. You will find you can do it with a degree of success that will be quite surprising.

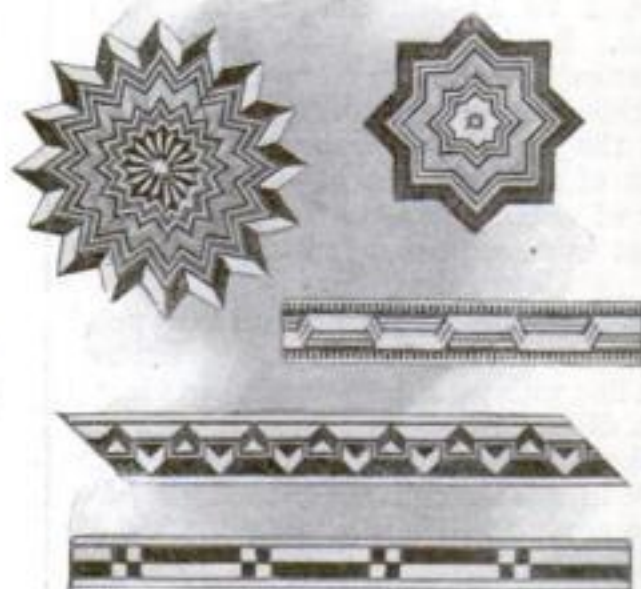
You will need first two 2 by 4 in. by 3 ft. blocks of wood, one side of each being

The borders are made of veneers, which are thinly sliced or sawn sheets of wood. Various woods are used, such as holly, walnut, mahogany, vermillion (or paduk), satinwood, and ebony. These are supplemented with red, blue, green, and black dyed veneers. Ordinary veneers of various thicknesses can be purchased from some lumber dealers and practically all veneer factories; dyed veneers can be obtained from dealers in inlays. It is, of



The four steps in making this simple border are typical of all geometric inlaid work

smooth. These are for gluing blocks. They should be provided with two U-shaped iron clamps threaded to take nuts as shown and two pieces of $\frac{1}{2}$ -in. flat iron drilled to fit over the ends of the clamps. Common iron C-clamps, if large enough, or cabinetmaker's hand-screws may be used instead of the special clamps, but are not quite so convenient.



Ornamental units and borders built up by the method illustrated in the adjacent drawings

course, a simple matter to dye white veneers any color with penetrating wood stains. Let the sheets dry thoroughly before attempting to cut or glue them.

To make a border such as shown in Fig. 4 of the accompanying drawing, take one piece of walnut $\frac{3}{16}$ in. thick, 4 in. wide and 3 ft. long; one piece of white holly of the same dimensions, and one piece of redwood $\frac{1}{30}$ by 4 in. and the same length. Lay the white holly on the smooth side of one of the gluing blocks and apply freshly made cabinet glue or the best quality of liquid glue freely with a brush all over it. Place the red wood on top and apply glue on the upper side. Then lay the $\frac{3}{16}$ -in. walnut strip on top, place the other "two by four" on top of all and clamp the whole together.

After the glue has set for at least six hours, you are ready to cut up this 3-ply strip in a miter box. If you have no miter box, you can quickly make one of wood, because only a straight, square cut is needed. Tack a small piece on the base of the miter box one inch from the saw slot, so that you can cut quickly a number of pieces—say 27—each 1 in. long. Then move the stop and cut a similar number $\frac{5}{16}$ in. long (Fig. 2).

On one of the gluing blocks, lay a sheet of white holly $\frac{1}{16}$ by 4 in. by 3 ft., coat

(Continued on page 99)

The Home Workshop

Method of Making Inlays

(Continued from page 98)

with glue and place on it a piece of blue veneer 1/16 by 4 in. by 3 ft. Tack a small piece of any kind of wood across one end and against it place one of the 1-in.-long 3-ply pieces previously made. Against it lay one of the 5/16-in. pieces, taking care that the holly goes against the walnut, as shown in Fig. 3. This must, of course, be well glued to the 1-in. block and also to the blue veneer. Now lay another 3/16-in. piece, then a 1-in. piece and so on until you have gone as far as you can. Tack a small strip tightly against the last piece so that the strips will not separate. Apply glue over the top, lay a strip of 1/30-in. blue veneer next, and then another piece of 1/16-in. holly. Lay down the other "two by four" and clamp the whole together. Let this stand at least eight hours.

All you now have to do is to cut your block up lengthwise into strips. You can suit yourself in regard to thickness. As a rule, borders are cut 1/12-in. thick, so that out of this piece, if 3 ft. long, you will get about 66 ft. of inlay 1/2-in. wide.

It is obvious that the same method can be used in making inlays of countless different designs. By making some of the cuts at an angle, it is possible to introduce angular lines into the pattern, as shown in the photograph on page 98. In exactly the same way geometric inlays for the center of drawer fronts, table tops, radio cabinet ends, and similar uses can be made.

TO LAY a border, use a marking gage to mark lines in the correct location. Make them a trifle closer together than the width of the border. Draw a sharply pointed knife over the lines, cutting them to a sufficient depth, and remove the wood with a small chisel. Do not make the groove as deep as the border, which should stand out a little when in place.

Cut right-angle corners at 45 degrees in your miter box. Lay the border strips tightly with plenty of glue. After eight hours or more, the surface can be planed, scraped, and smoothed with fine sandpaper.

If the piece is to be stained everywhere except the inlay, shellac the inlay first, so that any stain getting on it accidentally can be removed before it has a chance to penetrate. Apply wood filler if necessary, and then finish with shellac or varnish or both, rubbing the coats down with pumice-stone and finally with rotten-stone.

WHEN a varnish stain of a special or unusual color is required, it can be made by coloring a good grade of clear varnish with a strong solution of dye dissolved in turpentine or benzol. Strain the dye before adding it to the varnish, and do not add enough to make the varnish noticeably thin. If a very dark color is needed, it probably will be necessary to dissolve the dry stain directly in the varnish, afterwards discarding any sediment.



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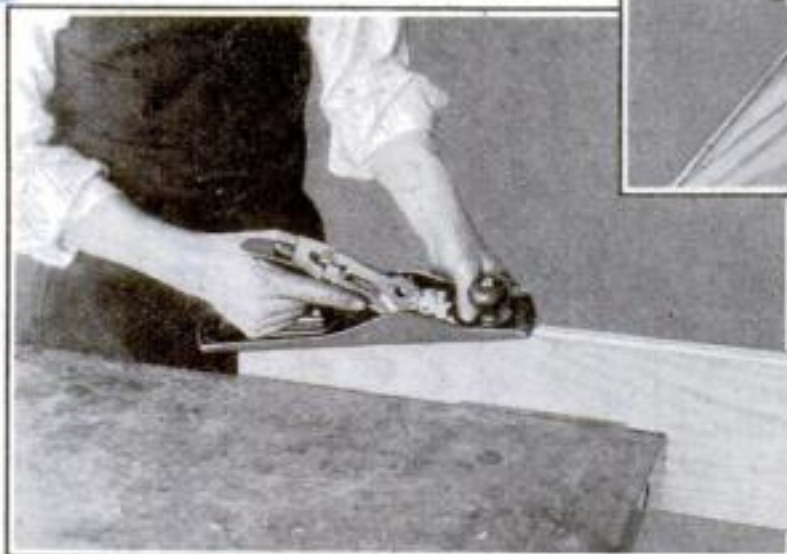
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The Home Workshop

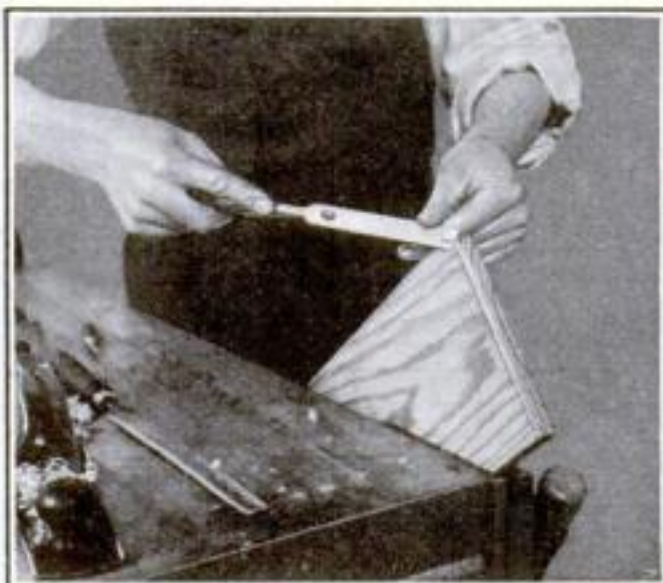
Rounding a Board's Edges

By Emanuel E. Ericson, *Noted Manual-Training Authority*

1 Thumb gaging. Use a fairly hard pencil with a sharp, slender point. Draw a line on both sides to show where the bevel will join the surface. Also draw one along the middle of the edge to serve as a guide when planing. These lines should not be removed until the last operation of all



2 Planing. Hold your jack plane at a slight angle if the bottom is corrugated. Tilt the plane with each stroke to prevent making a flat bevel on the board. Coarse shavings may be taken at first, then finer ones



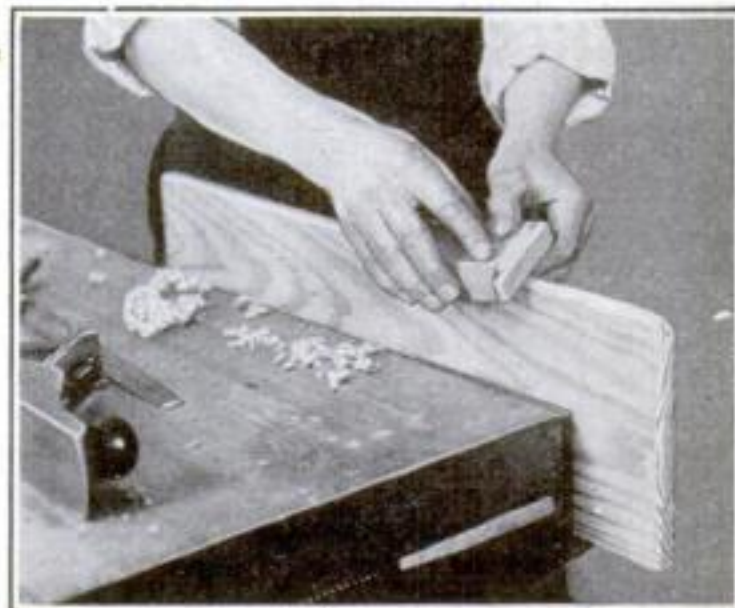
3 Chiseling rounded corner. The wood on a rounded corner or other curved surface is best removed with a chisel. The principle is the same as with the plane on the straight edge. Have your chisel as keen as oilstone and leather strop can make it. If the curve is large, a spokeshave is used



4 Filing corner. The corner is smoothed with a fine wood file (not a rasp) after the planing and chiseling are done. File on the pushing stroke and lift the file coming back. The file is not used on the straight edges, but it is an invaluable woodworking tool for finishing curved surfaces and shapes



5 Tear sandpaper with the rough side up over the bench corner or any sharp edge



6 The sandpaper is held over a soft wooden block. Change the angle with each stroke and do not work over the pencil line until the last

The Home Workshop

A Child's Playhouse

(Continued from page 75)

however, to make a small door, using either doweled or mortise-and-tenon joints, or even butt joints nailed with 20-penny finishing nails.

The framework is made almost entirely of rough 2 by 3's and 2 by 4's except the floor joists, which are 2 by 6, and the ridge, which is either 2 by 6 or 1 by 6. The floor beams are notched to take the 2 by 4 in. sills and then laid directly on the ground and carefully leveled. The method of framing is shown in detail. In some places, as alongside the windows, it is necessary to nail 1 by 3 or 1 by 2 in. filling pieces to the studs in order to provide an edge against which to nail the wallboard, if the application of the wallboard is left to the very last. The wallboard can, however, be applied before the inside door and window facings are nailed in place, so that the latter go over the rough edges of the wallboard. In that case, the window and door jambs will have to be made wider than shown by the thickness of the wallboard.

LAST of all, the baseboard should be nailed against the wallboard at the floor line. If the joints between the ceiling and the wall in the corners or elsewhere are not tight, they can be concealed by $\frac{1}{2}$ -in. quarter-round molding or any flat strips such as can be made by ripping lattice lath in half. It is so easy to cut fiber wallboard cleanly and accurately with a fine saw or a sharp penknife, and joints can be made so neatly, that in a playhouse of this kind no covering strips or moldings are really necessary.

The lumber required for the framework is 175 lin. ft. 2 by 3 in., 200 lin. ft. 2 by 4 in., 100 lin. ft. $\frac{3}{4}$ by 2 or $\frac{3}{4}$ by 3 in., 7 pcs. 2 by 6 in. by 6 ft. for floor joists, and 100 lin. ft. $\frac{3}{4}$ by 10 in. roofing boards. All this is rough lumber.

For the walls, 275 lin. ft. of $\frac{3}{4}$ by 6 in. drop siding is needed; for the roof, 3 bundles of wooden shingles, laid 4 in. to the weather. Composition shingles or roll roofing can be used, if preferred. Regular tongue-and-groove flooring $\frac{3}{4}$ by 2 $\frac{1}{2}$ in. is used, 65 sq. ft. being required. For the inside walls, 200 sq. ft. of fiber wallboard is ample.

The finishing lumber, which should be surfaced on four sides, will vary considerably, according to the number of windows and the closeness with which the work approximates the trim in a real house. If the house is made as shown, the following will be required: 100 lin. ft. $\frac{3}{4}$ by 2 $\frac{1}{2}$ in.; 60 lin. ft. $\frac{3}{4}$ by 3 in.; 100 lin. ft. $\frac{3}{4}$ by 4 in.; 60 lin. ft. $\frac{3}{4}$ by 5 in.; 20 lin. ft. 2 by 6 in., for making window-sills (or regular window-sill stock); 1 pc. $\frac{3}{4}$ by 6 in. by 2 ft., preferably hard wood, for door-sill; 30 ft. $\frac{3}{4}$ by 1 $\frac{3}{8}$ in. water-table molding. One roll of building paper, nails, hinges, door-lock set, paint, and varnish, also are required.

If the sash and door are not purchased ready made, sufficient 1 $\frac{3}{8}$ -in. stock is needed for their rails and stiles, as well as a sheet of plywood and window-glass.



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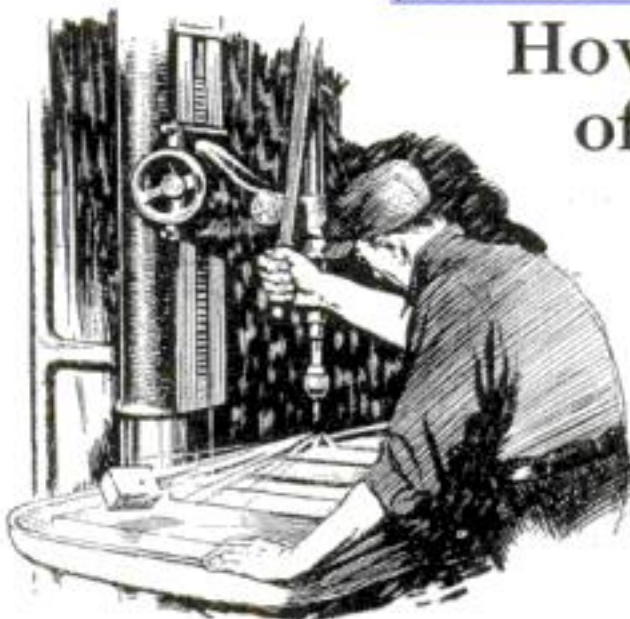
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Better Shop Methods

(Continued from page 82)

How to Make the Most of Your Drill Press



By F. J. Wilhelm

JOE, just starting to drill a lot of brass castings, had progressed no farther than his first hole when there was a clatter and a bang. The small casting, which he had been holding by hand on the drill-press table, broke from his grip. It spun around violently. Before he could stop the spindle, the drill snapped and the casting bounced away. A characteristic Monday morning start for Joe.

His foreman, who was making his early rounds, saw the mishap and inquired why Joe hadn't clamped the job on the table.

"Well," Joe explained glibly, "I thought it would take extra time and I tried to hold the casting with my hand. It went all right until the drill started to go through. It jumped so quick I couldn't hold it and it got away from me."

"Let me see the drill you were using." The foreman glanced at the cutting edge. "Get another drill," he said, "and I'll show you how to grind it for brass."

Joe brought another drill from the crib, the foreman stepped over to the emery wheel, touched up the edge and handed the drill back to Joe.

"You will see that I have ground the cutting edge flat; that is the way a drill should be for brass or bronze. You can't cut these metals like steel or iron. They have to be broken up and that is just what the flat edge is for—and to prevent the drill from digging in. Try that now and I don't think you will have any further trouble. But use a clamp on the job."

Figure 1 shows how the drill was ground. Most men think of a drill press as a machine simply for drilling holes, yet a drill press is a close rival of the lathe in doing stunts. Like the stunts performed by a circus elephant, many of them seem incongruous, but they are

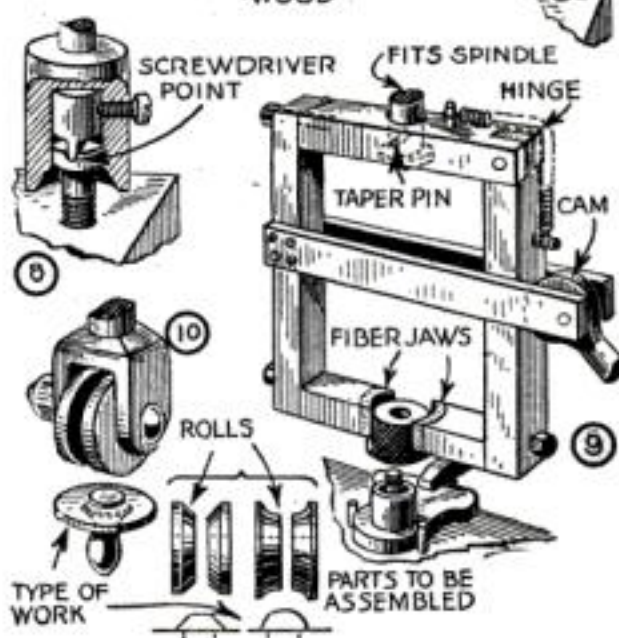
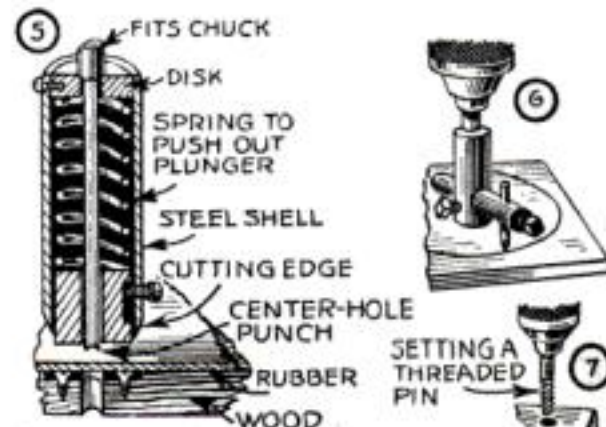
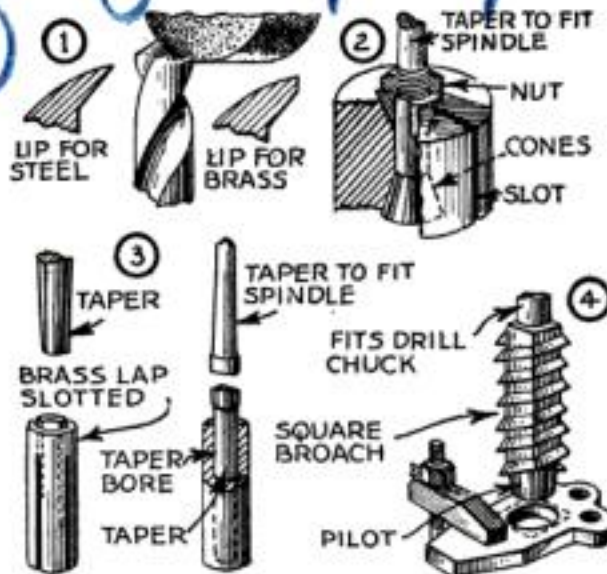
useful in many small jobbing shops and even in some of the large manufacturing plants where a drill press occasionally will be rigged up for some special job for which it never was intended.

Lapping holes in hardened-steel dies and in engine cylinders may be done in the drill press. Two forms of laps, Figs. 2 and 3, are useful. It is even possible to do some kinds of work with a lap made by wrapping a piece of emery cloth around a stick (Fig. 14).

A rough-and-ready substitute for a die-filing machine for dies having circular contours or round corners is a drill press with a piece of round file in the chuck (Fig. 15).

To cut large circular holes in plate glass requires nothing more than a short steel shank with a wooden plug on one end and a piece of brass tubing (Fig. 15). The plug fits snugly inside the brass tube, is charged with emery and water. Only light pressure is needed to cut a clean hole through the glass without chipping the edges. Figures 7, 8, and 9 are suggestive of how a

(Continued on page 103)



Methods of using a drill press for special purposes, when the shop equipment is limited

Better Shop Methods

How to Make the Most of Your Drill Press

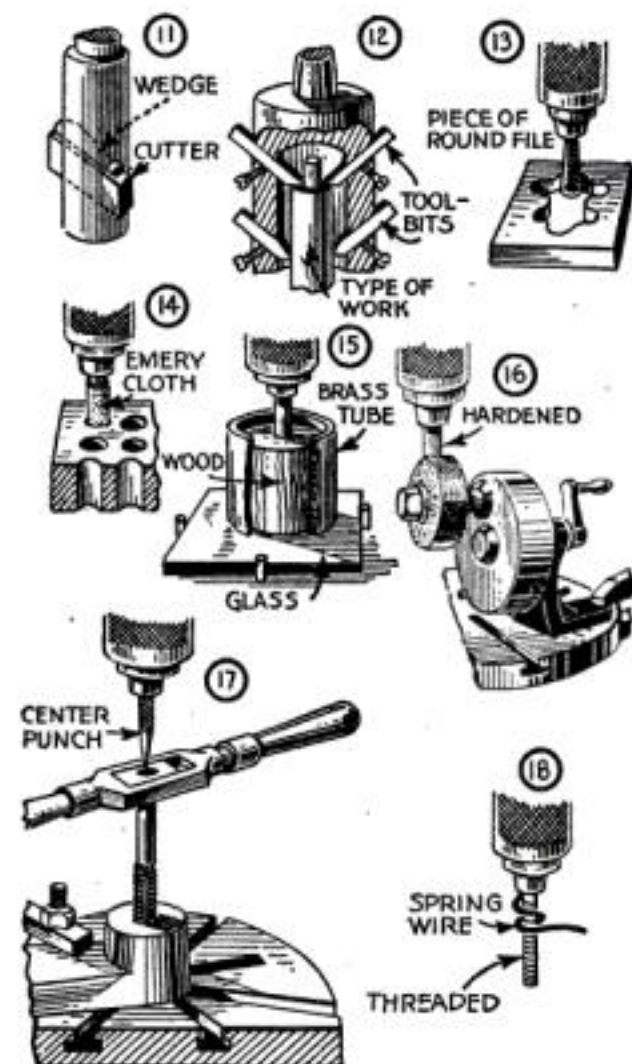
(Continued from page 102)

friction drive drill press may be used for assembling small parts. Among these operations are driving small studs and screws, and spinning rivets, as in Fig. 10.

Light broaching operations are feasible (Fig. 4) if a broach of conventional type is made with a shank to fit the chuck or spindle.

Two methods of cutting washers from rubber, felt, fiber, and similar relatively soft materials are indicated in Figs. 5 and 6.

Tapping holes with a drill press is made easier if a center punch is pressed



Using a drill press for boring, filing, grinding, lap ping, tapping, drilling glass, and making springs

against the end of the tap, as in Fig. 17, while the tap is turned with the wrench. This insures starting the thread squarely with the hole and lessens the danger of breaking the tap.

A simple method for locking cutters in a bar for spot facing and counterboring is shown in Fig. 11.

Figure 16 suggests a method of using a small hand grinder in connection with a drill press.

When a spring is needed in a hurry and all the lathes are busy, it is possible to grip the spring arbor in a drill chuck, as shown in Fig. 18. Start the wire in the usual manner and guide the pitch of the spring by hand.

How a box-turning tool may be adapted for use on a drill press is indicated in Fig. 12.

These all are ideas I have used at one time or another and have taught to many young machinists like Joe, who are not apt to appreciate fully the capabilities of a good drill press.

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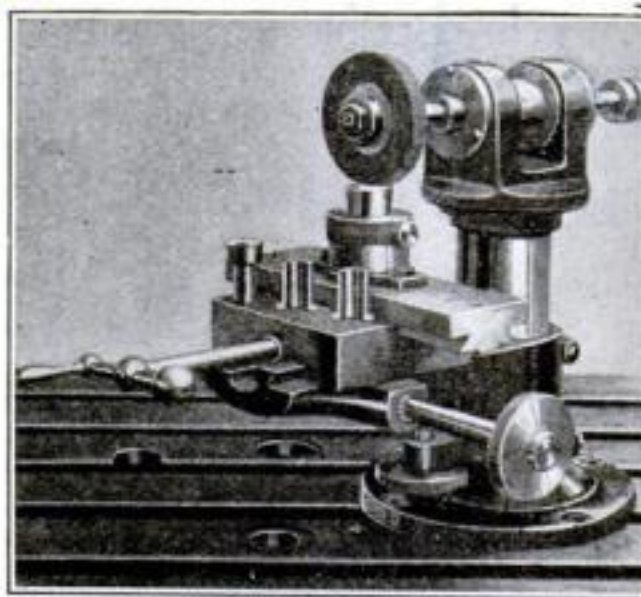
Better Shop Methods

New Lathe Tools Have Long Life

FOR plain turning and for special set-ups in gangs of two or more tools in turret work, a British engineering company has developed the circular lathe tool illustrated below. The design of the tool is simplicity itself. It consists of a body holder provided with a circular cutter, which is symmetrical in shape and can be produced by turning. Aside from the special cutting qualities claimed for it, the tool has the additional advantages of economy in the use of high-speed steel and a decrease in power consumption, a considerable increase in production, lower toolroom costs, and ease in handling and grinding.

As the tool can be rotated in the holder, any part of its circumference can be brought into use, as the clearance angle is uniform. For this reason it is said to have a much longer life between grindings than tools of rectangular shape.

The efficiency of this tool in comparison with an ordinary round-nosed tool was tested on a light cut $\frac{1}{8}$ in. deep with a $\frac{1}{8}$ in. feed. The speed of cutting was 115 ft. a minute, using a cooling compound, on a belt-driven lathe. The round-nosed tool failed after traversing the first 12 in. and was unfit for further use without regrinding. It was noted also that the speed of the lathe was reduced by the resistance of cutting from 115 ft. to 75 ft. a minute. In the case of the circular cutter working under exactly the same conditions, a dis-

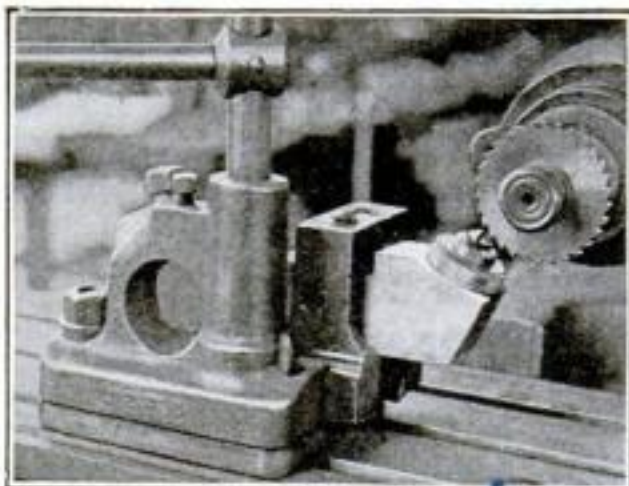


The circular cutter in its holder, a cutter blank and a fixture for regrinding cutters

tance of 12 ft. was traveled by the tool without any noticeable reduction in the cutting speed.

The tools are sharpened only on the top and this is accomplished in a special chuck or fixture on a surface grinder. As the tool wears and is ground down, it can be packed up with suitable rings.

Hand-Operated Slide for Small Milling Operations

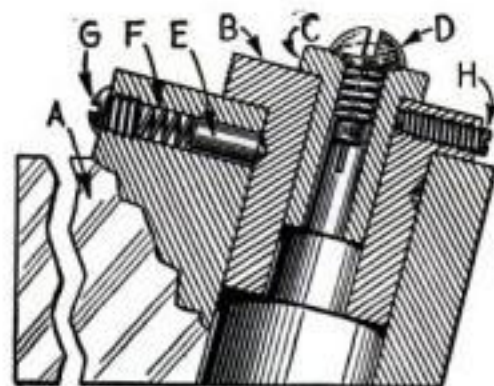


FOR numerous small slotting operations on screws, bushings, and similar work, a simple hand-operated slide adapted for use on an ordinary milling machine is exceedingly useful. The accompanying photograph shows one that is used regularly on a flat turret for slotting a screw.

The base of the slide is bolted to the platen of the miller, and the slide is reciprocated by means of the lever attached to the pinion-gear shaft. The slide is rack-cut a sufficient length to allow the necessary movement.

The drawing shows the construction of a simple fixture for holding a special type of screw *D* for slotting in four positions, on the quarters. The block *A* is held in the tool-pocket of the slide by a setscrew. Bushing *B* is knurled on its enlarged diameter or shoulder for hand manipulation

in indexing for the four positions. Bushing *C* is split in half so that it will separate readily to release the screw, which it holds in slotting. A flipper pin *E*, spring *F*, and screw *G* serve to retain and locks bushing *B* in holder *A*, and bushing *B* is



Indexing fixture for repetition work with the reciprocating slide shown at the left

spotted in four places for the index. Screw *H* binds bushing *C* during the cutting operation.

A stop screw is provided in the cut-off slide to control the length of stroke. With the machine table set in a convenient position, a simple motion of the slide lever only is necessary for light work of the kind shown.—O. S. MARSHALL.

TOOL steel can be annealed with water. Heat the piece slowly to a dark red, take it out of the fire and hold in the air until all the color has disappeared. Test with a match-stick or any piece of soft wood. If the wood does not smoke, the steel can be dipped into cold water.

Better Shop Methods

Old Bill Says—

YOU like to find a clean machine when you start a new job; remember this and after you have finished, wipe up the machine for the next man.

When drilling very hard steel, use turpentine instead of oil.

Try to find the quickest way to do everything; it makes your work like a game in which you always are matching your wits against a problem.



Old Bill, machine-shop foreman

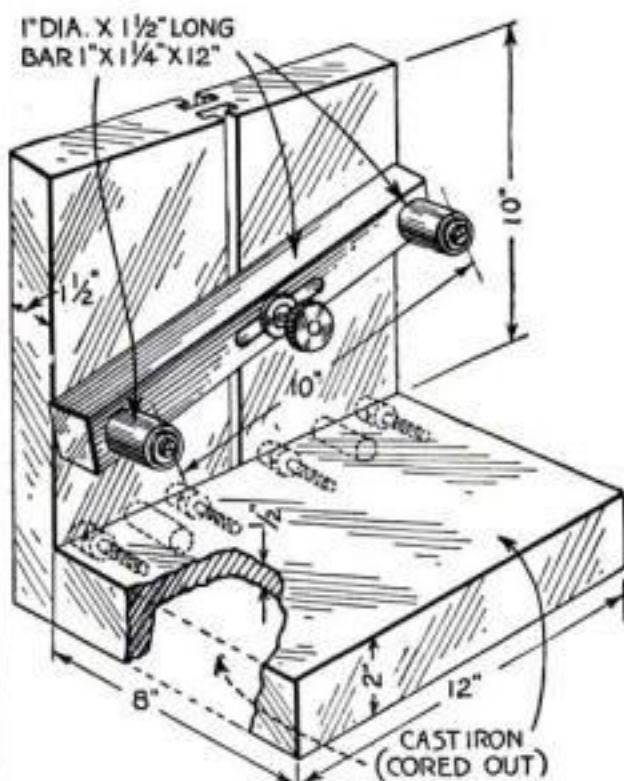
Oil costs money and should be put in the oil hole or cup where it belongs—not spilt over the outside of the machine.

Some one always pays for our blunders, if not in cash, then in consequences.

Loose sleeves have caused many a broken arm—play safe!

Beware a constant borrower!

How to Construct a Sine Bar for Large Angular Work



THIS sine bar for obtaining angles accurately is of especially heavy construction. It can be adjusted quickly and will hold its setting. The angle plate is made in two sections held together with dowels and screws. The pieces are ground on all sides before they are assembled. The T-slots in the vertical plate allow the sine bar to be used on either side, thus providing a wide range of adjustment.—H. L. WHEELER.

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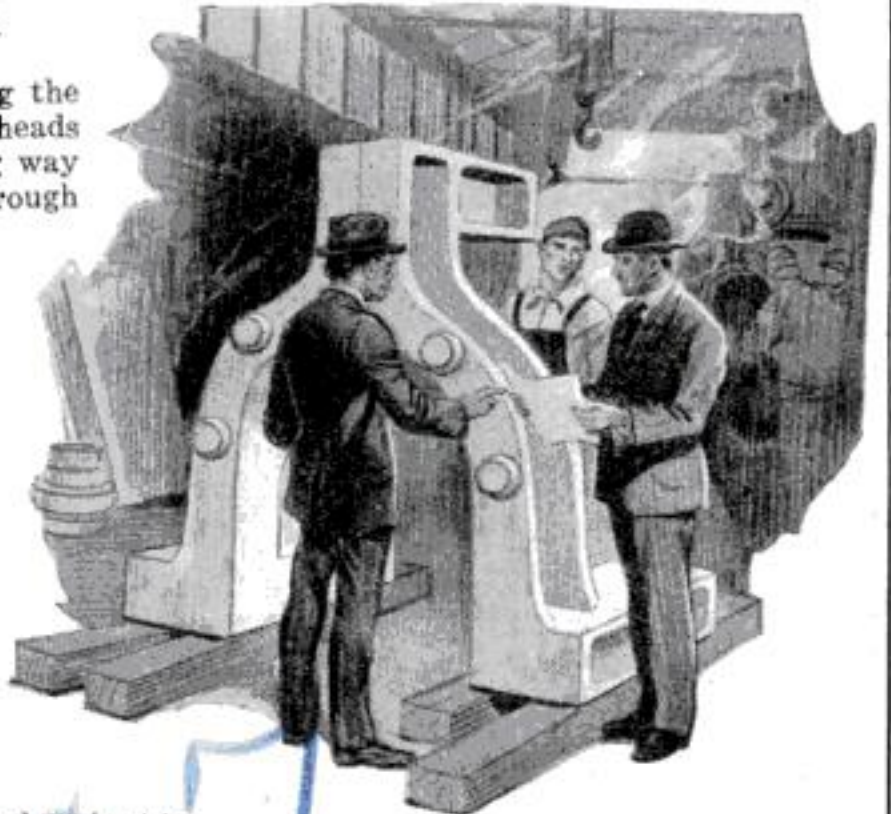
Cooperation between Draftsman, Pattern-Maker, and Foundryman

By M. E. Duggan

COOPERATION among the different department heads in a shop goes a long way toward smoothing out the rough spots. Whether some of these rough spots that nearly every mechanic encounters at times in his shop experience, are the result of bullheadedness or just plain indifference, I leave to the individual to judge. In my own case I have seen many shop problems where the right sort of cooperation could have saved hundreds of dollars and much needless worry and haste.

While on a visit to a foundry a while ago, the superintendent asked my opinion as how best to mold the patterns shown in Fig. 1, below. I studied the pattern from every angle and finally decided on just one way—to redesign the casting so that it could be cast in a "flat back cope" flask, as in Fig. 3.

The superintendent, however, decided to use the pattern as it was, on account of the small number of castings needed. The special flask shown in Fig. 2 had to

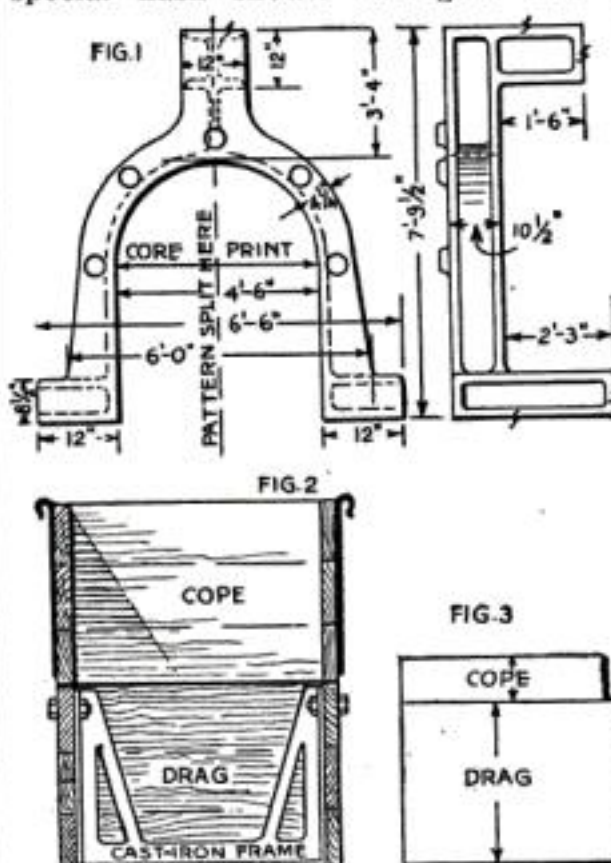


The superintendent and his foundry foreman ask an expert's opinion on a big pattern

"A good molder can mold any pattern provided it has 'two ends on it,' " is a common saying among foundrymen. However, cooperation in the drafting-room, the pattern-shop, and the foundry, and an occasional visit to these departments by the draftsman will give him a better understanding of how the work is done and will suggest ways in which he can use this information to his own advantage and to the interest of the company. He will be better able to make drawings that answer the requirements of both pattern-maker and molder without sacrificing strength or design.

THIS is the last article written for POPULAR SCIENCE MONTHLY by Mr. Duggan, who was regarded for at least a quarter of a century before his death as one of the foremost pattern-makers in the United States. In this message to mechanics he emphasizes again a theme that he believed to be of the utmost importance in every shop. He held that every mechanic and, of course, every engineer, designer, and draftsman, should make a determined effort to understand the other fellow's problems. Only through such understanding is real cooperation possible.

It is true that in this article he points out a defect and does little more than intimate the remedy—the redesigning of the casting. Probably the casting could not have been redesigned without the making of an entirely new pattern at a cost in excess of the building of the special flask. Perhaps, too, the element of time was exceedingly important, as it so often is, and the superintendent felt obliged to get the casting made without delay at any cost. But no shopman can fail to agree in Mr. Duggan's fundamental proposition, that the more we appreciate the problems and the difficulties of the other fellow's job, the better we can do our own.



A costly special flask instead of an ordinary one was required for casting this pattern

be made at a cost of \$120 to mold the pattern on its edge, as in the side view, Fig. 1.

Was that expense and trouble necessary? Absolutely no. A slight change in the design, which in no way would have affected the strength or the purpose for which the casting was to be used, would have made possible the molding of the pattern on its side.

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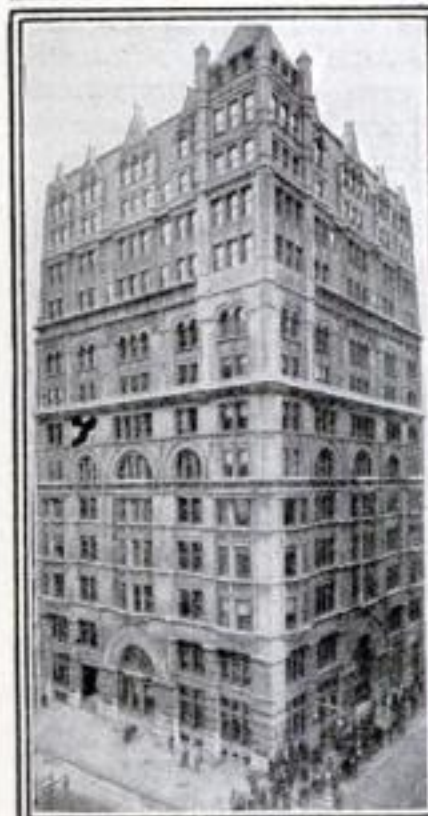
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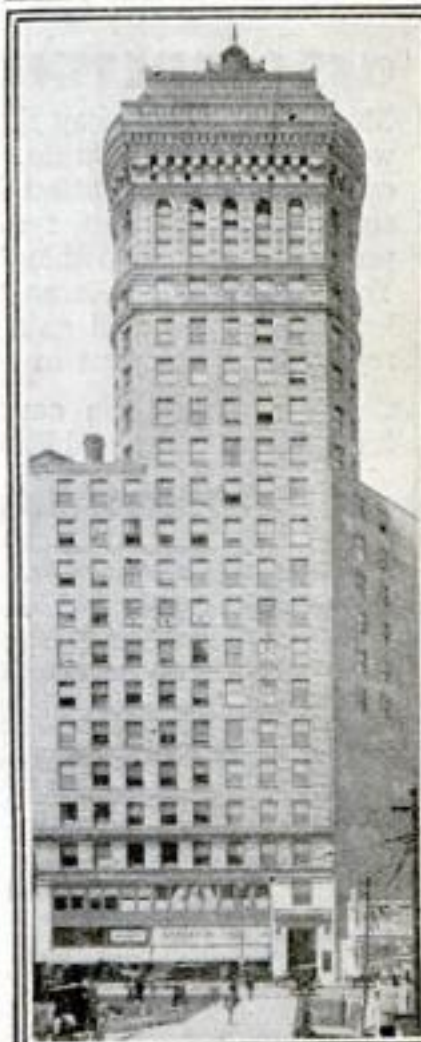
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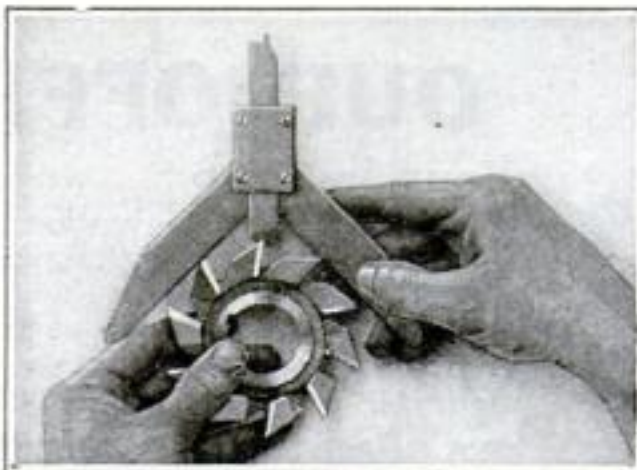
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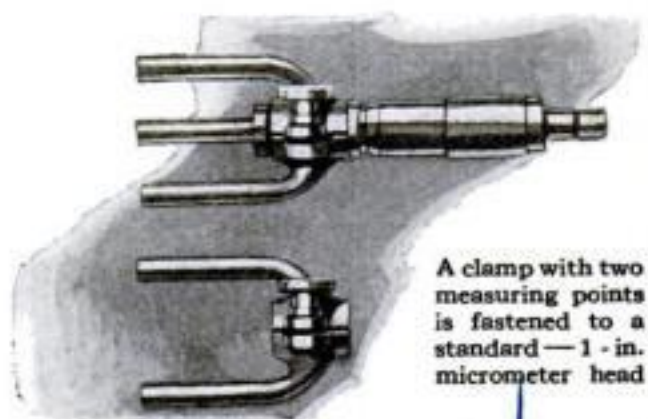
Better Shop Methods



Micrometer for Setting Boring-Bar Cutters

WHEN setting the cutters of revolving boring bars it is desirable to have some method of accurately determining the projection of the cutter from the bar. The accompanying illustrations show a micrometer devised by the writer for this purpose.

The upper view is the assembled device. A standard 1-in. micrometer head is mounted in a clamp that has two prongs or forked points. When the micrometer reading is .000, the three points are in line. Therefore, if the two outside points

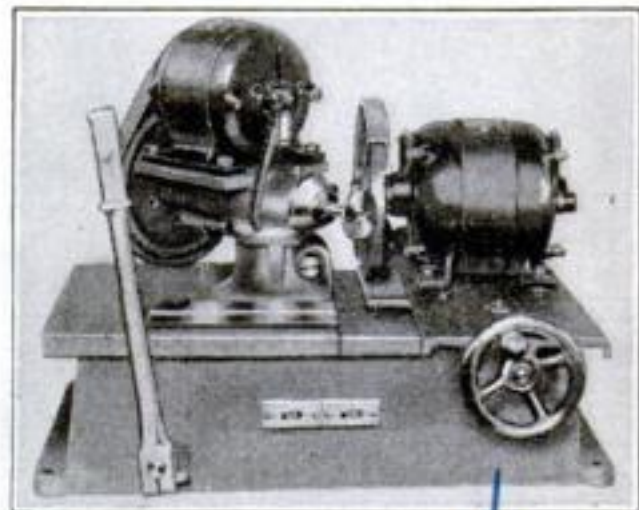


A clamp with two measuring points is fastened to a standard—1-in. micrometer head

are placed on the boring bar and the micrometer adjusted until the movable anvil just touches the cutter, the exact projection of the cutter will be shown. The size it will cut then is determined readily as the sum of the projection of the cutter and one-half the diameter of the bar will be the radius of the hole bored.

In the lower view the construction of the forked clamp is shown. The body is made of 11/16-in. cold-rolled steel, the two prongs of 1/4-in. cold-rolled steel, and the clamping lugs of mild steel. These parts all are welded together and finished as shown. A clamping screw with milled head is provided to hold the forked clamp on the micrometer head.—EDWIN KILBURN.

Two Motors Drive Sturdy New Valve-Refacing Machine



IN THIS new valve-refacing machine a conspicuous and valuable feature is the use of two electric motors instead of one. While one of them drives the grinding wheel at 3450 revolutions a minute, the other operates the work spindle through a gear reduction at a speed of 430 revolutions.

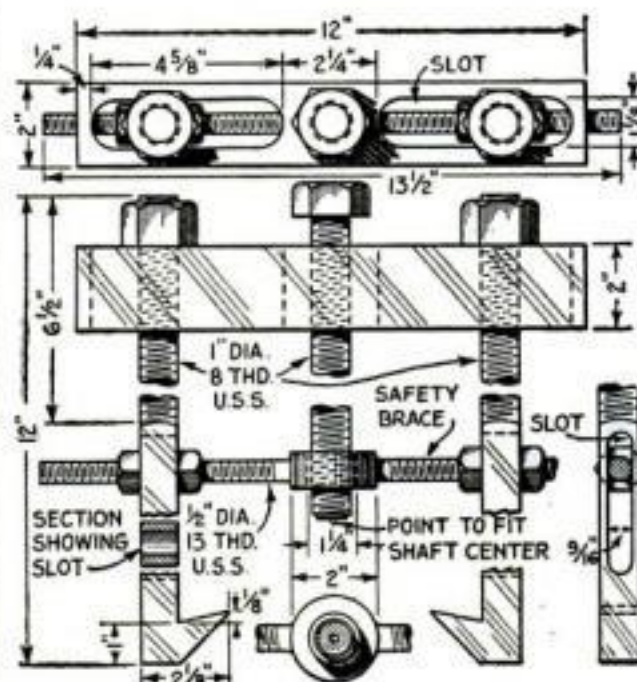
The valve is held by means of a collet. Three sizes of collets, to suit practically all auto valves, are provided.

New Clearance Gage Aids in Grinding Milling Cutters

TO AID in grinding the correct angle of clearance in milling cutters, the gage illustrated above recently was perfected. The V-shaped body is placed over the cutter and holds the gaging blade in correct relation to the center line. The cutter is revolved sufficiently to bring the face of a tooth in contact with the blade, whereupon the angle of the clearance in the tooth should correspond with the angle of the gage. The gage serves for both right- and left-hand cutters and for end-mills of all styles from 1/2 to 8 in.

Cross Brace Prevents Gear Puller from Slipping

BUILT for heavy duty, this convenient and substantial gear puller has a wide range of adjustment and is provided with a brace that prevents the spreading of the jaws whenever that might be likely to happen on difficult and awkward work. The elongated slots in the horizontal and vertical members



The gear puller in use, showing application of cross brace, and details of the tool

will allow quick adjustments to be made. To make one of these pullers requires little machine work except drilling and tapping.—HARRY M. CORNWELL.

Factory-Made Vegetables Our Future Food?

(Continued from page 21)

"Possession of the ultra-violet ray is the thing that has made it possible for us to succeed where previous generations have failed. For a long time there has been theoretical knowledge that the restoration of energy could be reproduced within our laboratories by the use of high temperatures, but from a practical standpoint the thing is impossible, for the reason that the very heat that could produce the delicate structure also would inevitably destroy them.

"The ultra-violet ray, on the other hand, has the same property of promoting anti-combustional changes as has heat and with the added advantage that it is not destructive.

"Under the influence of the ultra-violet rays, water vapor and carbonic acid gas are decomposed. The water vapor divides into hydrogen and oxygen and the carbonic gas takes the form of oxygen and oxide of carbon.

"**PROCEEDING** along these lines," Professor Berthelot went on, "we realize the light synthesis of formic aldehyde, the simplest of the ternary formations, or sugars. This comes from the combination of oxygen, hydrogen, and carbon.

"Going one step further, we accomplish the light synthesis of four elements—carbon, oxygen, hydrogen, and nitrogen. This gives us the lowest quaternary form, the starch called 'formiamide.'

"In other words, we have thus produced both sugar and starch from the elements without the intervention of living organisms. The low form of albuminoid starch is the beginning of the albuminoids or proteins, and is therefore the base of protoplasm and of living matter."

To scientists, this result of the Berthelot experiments is revolutionary—it is a step toward the possible laboratory production of at least one constituent of the living cell and may aid materially in the dream of all scientists, the production of life itself!

"Chlorophyll is the basis of our results," said the scientist, continuing his explanation. "This material is the essential element of plant life. It is the thing that gives vegetation its coloring of green. The green pigments enable plants to utilize the light energy of the sun for transforming the atmospheric carbon into a higher chemical. Chlorophyll makes life possible. By reproducing the fundamental reactions of the chlorophyll, we are able to create the sugars and starches pertaining to plant structure.

"**T**HE ultra-violet light, therefore, permits us to realize, without living matter, but in living form, the same synthesis as that of the plants. In subjecting aqueous vapor and carbonic acid mixture to the rays, by means of a mercury-vapor lamp, I have proved that these two gases combine to give the principal sugars exactly like those of plants. These experiments conducted with M. Gaudechon, show that by means of light, vegetable foods can be manufactured from air gases.

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Here Are the Rules in Our Great \$10,000 Contest

This Month's "What's Wrong" Pictures on Pages 30 and 31

1. Every month for four months, beginning in the June issue, POPULAR SCIENCE MONTHLY is printing a set of pictures of John and Mary Newlywed. Each of these pictures shows John or Mary doing some simple "job about the home" in an incorrect way. And, in addition, there is a deliberate error in the drawing of each picture. You are to tell us what two things are wrong in each picture and why they are wrong.
2. There are four complete monthly contests, each of eight pictures. The first was in the June issue, a second was in the July issue, the third is in this issue on pages 29, 30 and 31, and the last will appear in the September issue of this magazine. In addition, there will be a Grand Prize Contest covering all of the 32 pictures printed in the four months of the contest.
3. POPULAR SCIENCE MONTHLY will award \$10,000 in 580 cash prizes for the best answers submitted in the contest.

The cash prizes in each of the four monthly contests will be as follows:

First Prize.....	\$500
Second Prize.....	\$100
Third Prize.....	\$50
Next 5 Prizes, \$10 each.....	\$50
Next 60 Prizes, \$5 each.....	\$300
Monthly total.....	\$1000
Four months' total.....	\$4000
4. In addition, cash prizes in the Grand Contest will be paid as follows:

First Prize.....	\$2500
Second Prize.....	\$1000
Third Prize.....	\$500
Next 5 Prizes, \$50 each.....	\$250
Next 50 Prizes, \$10 each.....	\$500
Next 250 Prizes, \$5 each.....	\$1250
Total Grand Prizes.....	\$6000
Total Prizes.....	\$10,000
6. Answers to each set of eight pictures must be received not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to insure consideration in this month's contest, answers to the eight pictures in this issue, published July 10, must reach the office of POPULAR SCIENCE MONTHLY not later than August 30. Pictures received by this date will be entered automatically in the Grand Prize Contest also. Contestants, however, may enter additional answers later for the Grand Prize Contest, or may enter for the Grand Prize Contest any time before September 30, without having entered a monthly contest. Contestants also may hold the answers to all pictures until they have a complete set of 32 before submitting the answers, it being stipulated, however, that no such entry will be received after September 30.
7. Contestants may submit as many answers as they wish to pictures in either the monthly contests or in the Grand Prize Contest, but each must be submitted in good faith. Answers may be submitted on any kind of paper, but the writing must be legible and on one side of the paper only. Each picture will be numbered plainly and contestants must attach to their answers either the corresponding picture cut from the magazine or the number of the picture. The winning of one or more monthly prizes will not bar the winner from winning a Grand Prize, if he should submit answers.
8. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each entry. An entry with insufficient postage will not be received. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be returned.
9. Prize-winners in this month's contest will be announced in the January issue of POPULAR SCIENCE MONTHLY, published December 10. Prize-winners in the September contest will be announced in the February number. The names of the winners of Grand Prizes will be announced and the correct solutions published as soon as possible after the close of the final month's contest.
10. You pay nothing. Just prove your knowledge and observation. You need not purchase POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or examine one at any of the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. These contests are open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families. The officials of the Popular Science Institute of Standards will act as judges and their decision will be final. Acceptance of these rules is an express condition of each entry.

WHEN SUBMITTING ANSWERS

HOW TO COMPETE

IF YOU are unable to get the June and July issues of POPULAR SCIENCE MONTHLY containing the first two sets of Contest pictures, copies of these issues are available for your free use at the public libraries or at the offices of this magazine. Or, if you prefer, you can obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Ave., New York City

Searching Sahara Sands for a Lost Continent

(Continued from page 37)

Inland the trail of exploration leads through hundreds of miles of desert in search of remains of vanished peoples. Late last spring an expedition under Count de Prorok, and including eight Americans, completed a 2000-mile swing through southern Tunisia, Algeria, and the Sahara in four motor-cars, making a preliminary survey of prehistoric sites.

There are certain desert districts of southern Tunisia which, while they have already yielded traces of prehistoric man, at the same time have given evidence that their sands, abounding in fossilized remains, are a deposit of the sea.

IN ALL its explorations the expedition expects to collect thousands of specimens of flint instruments and other objects representing all periods of primitive man.

In the meantime, recent geological study and exploration have aroused new scientific speculation as to the possibility of an altogether different location for the lost Atlantis. At least three developments have contributed to this interest. One is a survey of the ocean floor, which reveals a vast bulk of land 1000 nautical miles wide, rising in mid-ocean and topped by mountain peaks, the tips of which pierce the surface to form the Azores.

Another is the recent thrilling voyage of William Beebe, of the New York Zoological Society, into the ocean wilderness of the Sargasso Sea, lying between Bermuda and the Virgin Isles. The story of his strange discoveries in this teeming mid-ocean jungle, as told in the May issue of POPULAR SCIENCE MONTHLY, has added new interest to the legend that this vast expanse of 400,000 square miles was the vanishing place of the lost continent.

A third development is the interesting theory, recently advanced, that the American continent slowly has been drifting westward. This theory, if substantiated, would give further weight to the location of Atlantis in mid-ocean; for, considered with the existence of such an island continent, it would help to explain how it happens that traces of early civilization so similar to that of Egypt have been found in Central and South America. If we imagine America 1000 miles nearer to Africa than it is today, with a vast island midway between as a stepping-stone, it is easy to picture the Atlantes drifting across the intervening waters in small boats.

THE story of Atlantis, as preserved to us by Plato, pictures the vanished continent as encircled by mountains, with a fertile plain in the center. Scattered through the mountains were rich and populous towns, and in the center was a magnificent city, with palaces of white, red, and blue stones. The soil of the plain produced rich crops. In the mountains were mines rich in ores.

Science says that the existence of an Atlantis is geologically possible. Archeologists see in the legend a dramatic answer to the mysteries of civilized man's origin.

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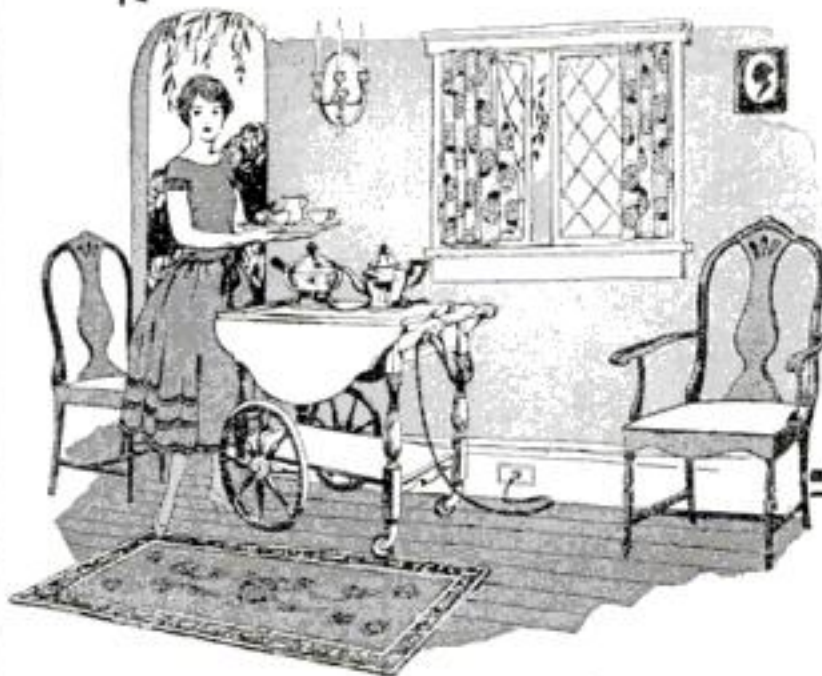
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A Beautiful Tea Wagon at Half Store Prices

Every woman wants one of these attractive tea wagons that are fast becoming popular in all well furnished homes. Not only are they ornamental and useful for serving tea but they can also be used to save steps in carrying food between the dining room and kitchen. To make a tea wagon in your home workshop costs a great deal less than to buy one. Success in building this tea wagon depends on having a good design and an adequate drawing or layout from which to work.

The tea wagon illustrated stands 28 inches high and has a top 20 by 30 inches. The two drop leaves are 10 inches wide and hinged at the top. The tray has a glass bottom.

A Blueprint of this handsome tea wagon—including full instructions for making—can be secured by sending 25c to



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Astonishing Things about Your Jewels

(Continued from page 35)

many times, but failed to find the hiding-place of the gems.

At the end of a year and a half the family reached China and the emerald cutter brought his emeralds to America, where he sold them for \$200,000. While he may never recover his properties in Russia, the future of his family was assured by that logful of jewels.

Nine persons in 10, if asked to name the most valuable jewel, would say, "diamond." The fact is, though, that in a table ranking gems in their order of value, carat for carat, the diamond has fourth place. Both emeralds and rubies are much more valuable, while the pearl is far above all others.

The finest pearls come from the Orient, in the Persian Gulf. These have a depth and brilliant richness of color unapproached by other varieties. Those with a rose-pink color are the most desirable. There are black, brown, salmon, yellow, bright red, green, and purple pearls, as well as the milky-white variety. They are found in more than 100 different shades.

THAT is one reason for the great cost of a perfectly matched pearl necklace. A dealer cannot go out and buy the pearls he wants. He has to collect them. Sometimes it takes years to do it, and he has to examine millions of dollars' worth.

While pearls are by far the most valued of gems, the most valuable single gem was a diamond. This was the Cullinan diamond, the largest and finest white diamond ever discovered. It was found in South Africa in 1905, in Tom Cullinan's mine, the Premier. This crystal, resembling a huge chunk of ice, proved to weigh 1½ pounds. It was split into nine separate stones (the two largest weigh 516.5 carats and 309 3/16 carats respectively), and 96 brilliants. The stones can be seen today in the Tower of London among the British crown jewels.

When I said that the prices of gems remained unchanged, I left out of consideration the effect of fashion which, by increasing demand, does cause a certain fluctuation from year to year. Fashion experts announce that "bracelets of emeralds are now very 'chic' for evening wear," and soon there is a demand for such bracelets.

FASHION has much to do also with the cutting of jewels. At present the fashion is to cut gems in the square or emerald cut. This follows the general trend of fashion in clothing. Twenty-five years ago curves were fashionable. Women were round. Today they are oblong, and accordingly, prefer jewels cut to match.

Cutting jewels is an exact science today. Until about 15 years ago jewel-cutting was left to the skill of the cutter. Now micrometers are used and every facet or side measured with minute exactitude to get the full benefit of refraction of light.

Flaws in the rough stone help determine, of course, the size and cut of the stones taken from it. About two-thirds of a rough diamond is lost in the cutting.

It is impossible to cut emeralds or sapphires so that they have no flaws. All have them.

People often ask how to take care of their jewels. Will water hurt them? Will they keep in better condition if worn than if put away?

PEARLS need far more care than any other gem, for they are an animal product that can be destroyed.

An estate was being settled recently and a string of pearls was brought to me for appraisal. I had handled that same string 15 years before and was greatly surprised at its changed appearance. The pearls had worn barrel shaped. Each was long and thin. I made some inquiries and found that the owner had the habit of wearing her pearls at night while sleeping. At night the largest percentage of acid is thrown off through skin pores and this had dissolved the pearls.

These particular pearls were restored by peeling. A pearl is made of layers, like an onion, and these outer layers can be removed until the pearl has become round again.

The peeling process is a most delicate task. It is done with the fingernails and a sharp knife. Only a few men in the world know how to do it.

Face powder is bad for pearls. It clogs up the pores of the pearl's skin, just as it does those of the human skin. Pearls should be wiped off with a soft cloth before putting them away, to remove powder and acid.

The opal is another gem that requires great care. Made of silica and water, it is very fragile. It was probably because of this that superstitions of bad luck have been associated with it.

Water, as a rule, will not injure precious stones. Diamonds, rubies, and sapphires can pass through fire without injury. It is comparatively easy, though, to destroy both emeralds and diamonds. They will shatter to bits if struck sharply.

"HOW can I tell if jewels are real?" The more people hear of the cleverness with which precious stones are imitated these days, the more they are asking this question.

Any one can test a pearl for himself. Many artificial pearls are hollow glass beads, with a sort of fishscale lining, a product of a small Mediterranean fish. These can be detected by rubbing the pearl gently over the edge of your lower teeth. If it is a glass bead it will feel perfectly smooth. If it is a real pearl it will be slightly rough and grating.

A Japanese cultured pearl cannot be detected in this way, for its outer structure is exactly like that of a real pearl. It is a pearl formed by an oyster about a core of mother of pearl that has been slipped in the shell. One way of distinguishing Japanese cultured pearls from real ones is examining them under a lucidoscope. By means of this machine one can look through the pearl and distinguish the core.

Beware of Sunburn

(Continued from page 39)

presence of pigment in the skin aids in transmission of light. That is, after you have acquired a coat of tan, the ultra-violet light can get through your skin, enter the blood, and be diffused through the body without being stopped on the way to produce a chemical burn.

Recent tests indicate that there may be relief for non-tanning skins in a preparation containing esculin, derived from

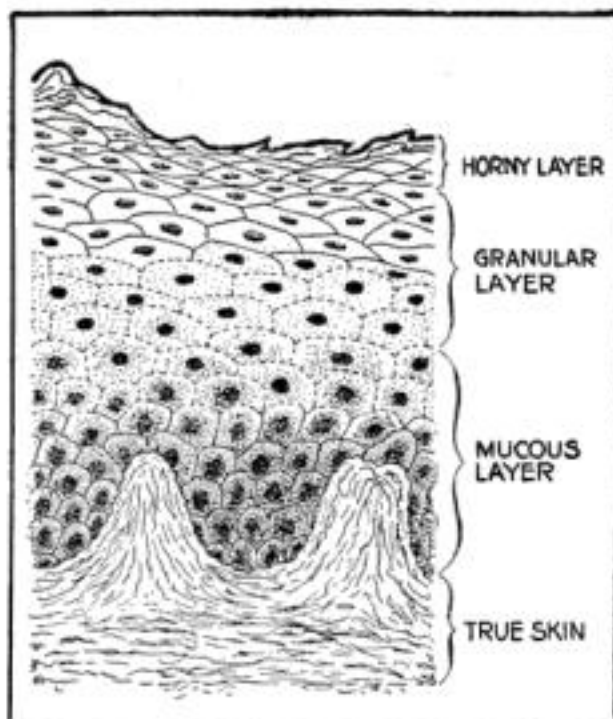


Diagram showing the construction of the skin. The protective pigment that produces tan and freckles is manufactured in cells of the deepest of three layers forming the epidermis, or outer skin, that covers the true skin. The pigment looks like specks of brown paint and is represented by the small dots in the diagram

horse chestnuts. This is put on before exposure to the sun.

When you fish or lie in the sun for hours at a time, exposing skin that has been protected all winter, you are inviting trouble. The skin cannot manufacture pigment quickly enough or in large enough quantity to protect you from burns.

Burns may be considered in three classes—first degree, when the skin is simply inflamed; second degree, when blisters are formed; and third degree, when charring takes place. A burn of the first degree, covering the entire body, probably would result in death. A blistering burn on half the body would be as severe, and a charring burn on a third of the body, equally so. That is, a superficial burn is as serious as one that blisters, if covering twice the area.

You probably have noticed that you have suffered your worst burns while you were on water in a boat. That is because water reflects ultra-violet light and this reaches your face and eyes, even if they are protected from direct rays of the sun by a hat. Some of the light penetrates water, so that you may be sunburned even while swimming.

One of the best and simplest treatments for shock from sunburn, is to get into a tub of lukewarm water into which a pound of bicarbonate of soda has been dissolved. A physician always should be called, since heart stimulants may be required to prevent collapse. Any sort of fat helps to sooth sunburn. Either lard or butter can be used in an emergency.



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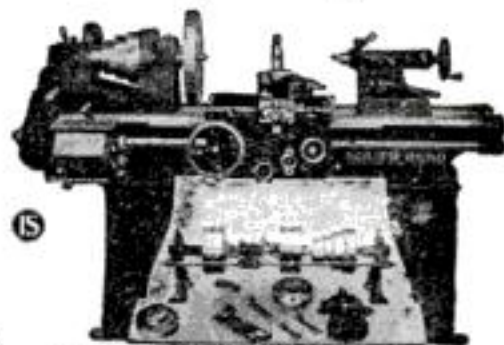
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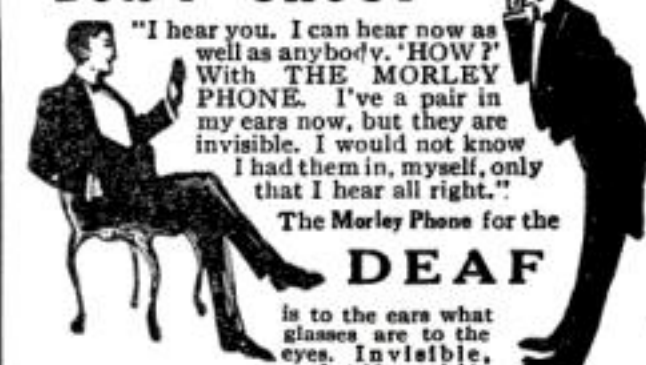


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Country Schoolmaster Stirs the World

(Continued from page 27)

and thus environment was a large factor in producing new types of creatures.

Scientists, who became convinced of the truth of this theory, held, too, that man took part in this general scheme.

Darwin himself said that scientific facts indicate that man's nearest kin was the Old World monkey.

"But," added Darwin, "we must not fall into the error of supposing that the earthly progenitor of this whole simian stock, including man, closely resembles existing apes or monkeys. What evolution shows is that the five great vertebrate classes—the mammals, birds, reptiles, amphibians, and fishes—are descended from one prototype—probably a fish."

This theory has been borne out by geological and fossil discoveries made since Darwin's day by scientists in many parts of the world. Fossil remains found in the rocks indicate, according to the conclusions of science, that in one period of the earth's history its animal inhabitants emerged from the sea and became land dwellers.

It is to this theory that anti-evolu-

tionists object. They hold that the earth and its plants and its animals were created as described in Genesis, the first book in the Bible; that to accept the theory of Darwin and his followers is to strike at the foundations of religion.

It was to prevent the further promulgation of this theory that the legislatures of Tennessee and Oklahoma enacted statutes making it unlawful to teach the theory of evolution in the public schools of those states; that in 15 of the remaining 46 states either anti-evolution legislation has been instituted or other means taken to prevent the teaching of the theory in the public schools.

Evolutionists, however, insist that to hold the theory offers no challenge to religion or to belief in a creator. The evolutionist, they admit, cannot accept the story of the ark, of the creation of the world in six days or 24 hours, and of the separate creation of man and the other animals. He can, though, they say, believe fully in a creator who made a world in six geological eras; a place in which evolution began and continued.

Some Inventions and Discoveries

(Continued from page 49)

according to Dr. Carl Murchison, professor of psychology in Clark University, after testing the mentality of several thousand criminals and comparing the results with those of tests on army men.

New Cars and New Fuels

FRONT-DRIVE automobiles will be the next improvement in motor-cars, in the opinion of Capt. Eddie Rickenbacker, manufacturer and former race driver. Cars of this type now being used for racing, show great speed. With power going into the front wheels, practically all skidding is said to be eliminated.

These new cars may be run on ether, or with a fuel derived from molasses, it is reported. E. C. Freeman, chemical engineer, discussing these possibilities before the American Chemical Society recently, declared that the use of ether would do away with dirty cylinders, since ether burns with no solid product of combustion. Molasses fuel, he added, would give great power combined with smoothness of operation and ease in starting.

Another fuel possibility is a new synthetic alcohol known as "methanol," imported from Germany. It is a wood alcohol produced from coal and water, and is a result of researches carried on in Germany during the war, to find a substitute motor fuel.

The Moon Snatched Away?

THE moon was stolen from the earth. A layer of the earth's crust about 41 miles thick and covering two-thirds of the globe's total area was pulled off by the sun's attraction. It rolled up into a ball and became our beautiful satellite. This new and interesting theory was announced recently by Dr. R. H. Rastall, lecturer in

economic geology at Cambridge University.

What remained of the earth's crust after this had happened became the continents. According to this theory, if we had no moon we might have no oceans, for these occupy the space once covered by crust.

This explanation fits in well with the ideas of a German geologist, Prof. Alfred Wegener, who believes that the American continent originally was united with Europe and Africa, and floated away to where it is now. This might have happened when the moon was torn away.

An Unnamed New Gas

DURING the recent eclipse an unfamiliar gas was observed about the sun by scientists who were making careful observations. But, according to Prof. Frederick Slocum, head of the Van Vleck Observatory at Wesleyan University, who recently made the announcement, scientists are not yet prepared to name the gas or to discuss its properties.

The Next Total Eclipse

DOCTOR J. A. MILLER, director of the observatory at Swarthmore College, whose interesting story of this year's solar eclipse appeared in POPULAR SCIENCE MONTHLY recently, is getting ready to journey halfway around the world to the west coast of Sumatra, to observe the next total solar eclipse. It is scheduled to appear on January fourteenth of next year. The narrow path of totality passes over East Africa, Sumatra, and the Philippines.

RASPBERRIES as big as blackberries that grow in the Andes Mountains are suited to cultivation in California, recent experiments have shown.

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Insects in Your Back Yard

(Continued from page 45)

daily to forage for food. A few days later they move to a large fork of the tree and construct an ugly web. The family sticks together, resting in the tent during storms and the heat of the day, going out when it is cool for food. They are very easily killed when they are gathered in their tents.

When the larvae are fully grown they become more venturesome and strike out, hunting for protected places in which to spin tough, oval, white cocoons. These, as well as the egg masses, can be picked off of trees easily and destroyed.

By contrast there is the peach-borer, which is said to do yearly damage amounting to \$6,000,000. The adult is a moth with skeletonized wings that look as if they were covered with varnish. The caterpillars bore in trunks and roots of peach-trees and also infect the wild cherry and willow.

You can tell that trees are being bothered by this pest by large masses of gum exuded from the trunk where the caterpillars are working, usually near the ground. When the caterpillar has reached its full growth, it leaves its burrow and makes a cocoon of pieces of bark and silk on the tree trunk or ground. These cocoons can be removed and destroyed, but they are exceedingly well hidden and the damage already is done.

TWO hundred and forty-eight varieties of butterflies and moths were found in Doctor Lutz's yard. These vary in size from those as big as a small fly to specimens of the gorgeous tiger swallowtail with its striking golden wings striped in black.

On a summer evening when you hear the chorus in the garden, you are most likely to appreciate the size of the vast army of insects there. The grasshoppers, for example, announce themselves by a peculiar rasping sound made by rubbing their hind legs against their front legs or by rattling their hind wings while flying. These extraordinary sounds, we are told, are love songs and their beauty is appreciated only by the female grasshopper, who is equipped with special sort of ears, one on each side of her abdomen.

Insects, just as human beings, often are misjudged from their appearance. The dragon-fly, for example, looks vicious, so we give it the innocuous title of "devil's darning-needle" or "horse-stinger." As a matter of fact, it stings neither horse nor man and is dangerous only to other insects. It catches these by swooping upon a victim and scooping it up in its legs, curved to form a basket.

The hundreds of insects in your garden all are interesting if you know how they live, what they eat, and how they grow. On your window-screen there are perhaps 20 flies of different sizes. There are 20 different kinds of flies, for a little fly does not become a big fly. Insects do not grow after they have wings. Each of these 20 species has a story.

With the rich field of entomology just outside your kitchen door, in your own back yard, you have only yourself to blame for neglecting a fascinating study.

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Here Are Correct Answers to Questions on Page 55

1. Because the paper keeps the ice from melting and this interferes with the cooling effect of the ice. When ice melts it takes up and absorbs a certain amount of heat in the mere act of melting. This is what you use ice for; to take up heat.

2. If the temperature of the body itself gets above 107 degrees, even for a short time, death is nearly certain. The body can withstand an outside temperature much higher than this.

3. Lack of air does not cause actual death until the tissues of the body have been without oxygen for some time and have suffered serious chemical changes as a result. If you restore breathing artificially before these changes happen, the tissues will recover.

4. We are not sure. Bats may have some extra sense we do not know of. But scientists believe that bats possess extremely sensitive ears and can hear echoes reflected from walls, trees, etc.

5. Because it stays the same height in the sky. Anything on earth, like the top of a church steeple, seems to sink lower toward the horizon as you go away from it. Of course the moon is much too far away to do this.

6. The fundamental cause is that the water in the tropics gets hot and the water in the polar regions gets cold. This starts a circulation of the water.

7. The color of clothes is usually due to dyes. Dyes are very complex chemical compounds. Many of them are affected by light, changed into other chemicals.

8. The sign contains a great number of electric lamps, each one connected separately with a switch. These switches are mounted on a revolving cylinder like a barrel. This cylinder is turned by a motor. As it revolves the switches open and close. This makes the individual lamps on the sign light up and go out in succession to form designs.

9. Because the gas-pipes are not always connected electrically with the earth.

10. In some kinds of plants this is caused by fall of temperature at night; in others it is caused by lack of light. These latter flowers will close up any time if carried into a dark room.

11. One of the functions of the liver is to store up sugar and hold it as food material which can be drawn out and used whenever there is an emergency. When the adrenal glands are preparing your body for a fight, one of the things they do is to affect the liver so that some of its stored-up sugar is poured out instantly into the blood. This sugar then becomes available as a quick food supply for the muscles in case they have to work very hard fighting or running.

12. We all have an unconscious tendency to imitate whatever we see other people do. If everybody around us is in a panic, or laughing, or running to a fire, it makes us want to do the same thing. Yawning when other people do so is simply one instance of this tendency to imitate. It is such a common instance because yawning is an easy thing to do and one which we are much more likely to do than we are to get in a panic or run to fires.

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Facts about Tuning Coils

(Continued from page 70)

Of course, other conditions might enter into any consideration of the effect of moisture, as far as the average radio set is concerned. In the first place, these test coils were absolutely clean—not covered with a layer of dust and grime that would help to keep the water in contact with the wire and even absorb it from the air. It seems fair to assume, however, that any radio set kept reasonably clean and in a house where the dampness is not so great as to injure the health of the inhabitants, should give good results so far as any effect of moisture is concerned.

In connection with the test of the comparative efficiency of silk, cotton, and enameled wire it might be well to point out that the material of the tubing on which the coil is wound probably is of great importance. At least, it is obvious that if the tube composition is of a type that tends to increase the high-frequency resistance, then the thinnest insulation would naturally give the greatest resistance, because it would allow the wire to come that much closer to the coil form.

The Popular Science Institute of Standards Radio Laboratory is now planning a series of tests on coil forms made from different kinds of material and the results of these tests will appear in a future issue of POPULAR SCIENCE MONTHLY.

Recent Publications

Concerning the Nature of Things, by Sir William Bragg. A thorough explanation, making clear to the layman, through simple experiments and homely illustrations, the structure of atoms, gases, liquids, and crystals. Illustrated. Harper & Brothers.

Roper's Questions and Answers for Steam Engineers and Electricians. What a capable engineer should know. A handbook enlarged and brought up to date. David McKay Co.

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Man and His Affairs from an Engineering Point of View, by Walter N. Polakov, M.E. Williams & Wilkins Company.

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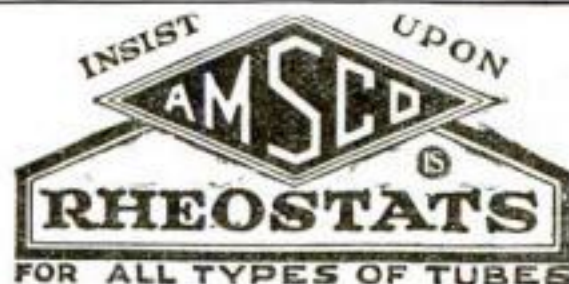
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A Compact Two-Tube Receiving Set

(Continued from page 67)

of rheostat *G*. From the other terminal of rheostat *G* run a wire around underneath variable condenser *D* to the remaining filament terminal of socket *J* and from there to the remaining terminal of socket *K* connecting, also, with binding post No. 5.

After this you should connect the lower terminal of coil *B* with the stationary plates of variable condenser *D*, and connect the other terminal of coil *B* with the rotary plates of condenser *D*. Continue this wire to connect with the wire that

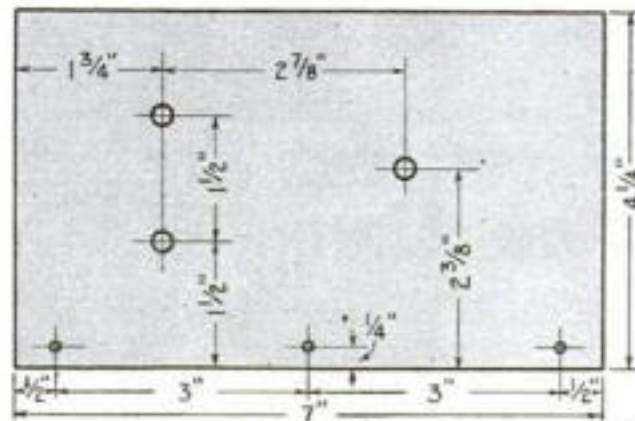


Fig. 8—The panel diagram, with the exact measurements for laying out and drilling holes

joins the positive filament terminals of sockets *J* and *K*.

Now run a wire from the other end of the stationary plates of condenser *D* to one terminal of grid condenser *E* and connect the other terminal of condenser *E* with the grid terminal of socket *J*.

NEXT, connect one terminal of coil *C* with the wire from rheostat *G* that goes to the filament terminals of the sockets. Connect the other terminal of coil *C* with condenser *F* and run a wire from the other terminal of condenser *F* down to the plate terminal of socket *J*, with a branch over to the *P* terminal of audio transformer *H*. Now connect the grid terminal of transformer *H* with the grid terminal of socket *K*. After this you can run a wire from the plus-B terminal of transformer *H* down to binding post No. 6 and continue it on to binding post No. 7. Then connect the plate terminal of socket *K* with binding post No. 8.

Connect one end of coil *A* with the wire from the filament terminal of socket *K*, which also is connected with the rotary plates of the condenser. Complete the wiring by connecting the other end of coil *A* with binding post No. 1.

To put the receiver into operation, connect the antenna wire with binding post No. 1 and the ground wire with binding post No. 2. The *A* battery is connected with binding posts Nos. 3 and 4; the positive terminal with No. 4. The *B* battery is connected with binding posts Nos. 5 and 6, the positive with No. 6, and the head-phone cord tips should be clamped under binding posts Nos. 7 and 8. If the cord tips are marked "positive" and "negative" by means of a thread in one cord, be sure that this tip is clamped under No. 7.

Turn the rheostat all the way off and place the tubes in sockets *J* and *K* and the grid leak *L* in the clips on condenser *E*. Now turn on the rheostat *G* until the tubes

are burning faintly and then tune the set with the dial on condenser *D* and the knob on the shaft that turns coil *C*. Be sure that you keep the knob that controls the angle of coil *C* turned back to the point where the receiver does not howl.

THE efficiency of any receiver depends on the antenna you use and if you are a long way from any broadcasting station, the higher and longer the antenna, the better the results you will get. In building the case for your complete portable outfit, it will be well to figure on a coil of flexible wire about 100 feet long and if you find that there is no location for an antenna as long as this in your camp, then make the antenna as long as possible with the unused portion of the coil rolled up tightly at the far end of the antenna.

A good ground connection is just as important as a good antenna. A piece of wire thrown into a near-by brook or lake is the best obtainable. If you are not near water, then a very fair ground can be obtained by laying 100 feet of wire on the ground underneath the antenna, or you can drive an iron rod into the ground.

The frame of your auto also will give fair results as a ground connection and if you are using the storage battery in your car to light the tubes in this portable set, no special ground connection with the frame of the auto will be necessary.

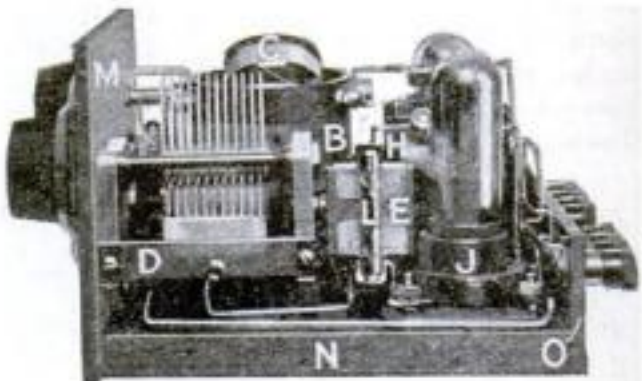


Fig. 9—View from the right end showing clearly the hook-up of the tuning condenser

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New Finish for Autos

AUTOMOBILES now can be refinished quickly by spraying on, with compressed air, a very durable finish made of much the same material as that used for the backs of imitation ivory toilet articles.

Summer's the Time to Overhaul Your Set

(Continued from page 68)

as possible, means that either the plates are badly sulphated or that the positive plates are going to pieces. A storage A battery can be overhauled, but it is practically as economical to buy a new battery.

The sound-producing part of your equipment—the head phones and loud-speaker—should be left strictly alone. Do not try to take them apart or try to adjust them except, of course, for the usual spacing adjustment fitted to many loud-speakers. This rule does not prevent you from carefully inspecting the flexible cord, and if you find the fabric broken or frayed, the whole cord should be replaced.

Like any other piece of delicate apparatus, a radio receiver responds to intelligent care and it pays to watch for troubles that may stop your reception some evening just when you are trying to show friends how well your set works.

Resistance of Water Found

THE resistance of water to electric currents increases in the same measure as its purity. This does not mean, however, that absolutely pure water is an insulator. It has been determined that chemically pure water offers a resistance to electric current which is 45,000,000,000,000 times that of copper. A column of pure water .039 inch long and .039 inch square in cross section offers the same resistance as a copper wire .039 inch square in cross section and 27,000,000 miles long—more than 100 times the distance from earth to moon.

What Becomes of Pins?

IT SEEMS almost incredible that each person in the United States uses 200 pins a year, yet according to the output of the 10 large factories supplying the great demand for pins in this country, the United States now uses more than 20,000,000,000 pins a year.

ANTS do not like castor oil, for Brazilian agricultural experts have found that the slowly burnt seed of the castor-oil plant produces fumes that not only kill the ants, but prevent the nest from being reinfested.

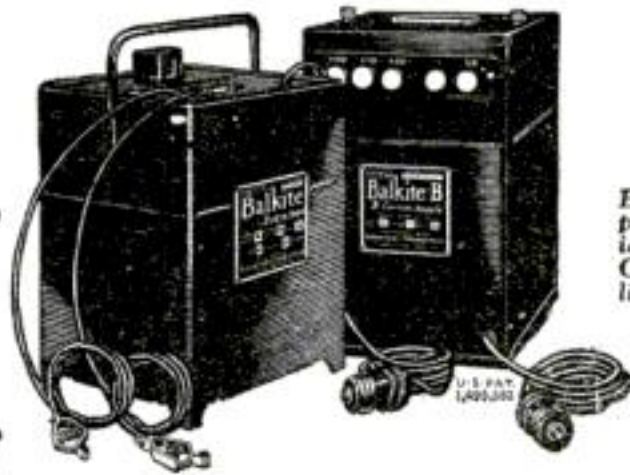
REMAINS of a hitherto unexplored prehistoric city of the cliff-dwellers buried under water when Roosevelt Lake was formed by the erection of the great Roosevelt Dam were exposed by recent droughts which lowered the lake level.

PART of the heart muscle of an unborn chicken has been kept alive in a test tube for 14 years, according to the recent statement of Dr. M. J. Sittenfield of New York.

FRENCH chemists have developed an artificial resin from which panels for radio sets are to be made.

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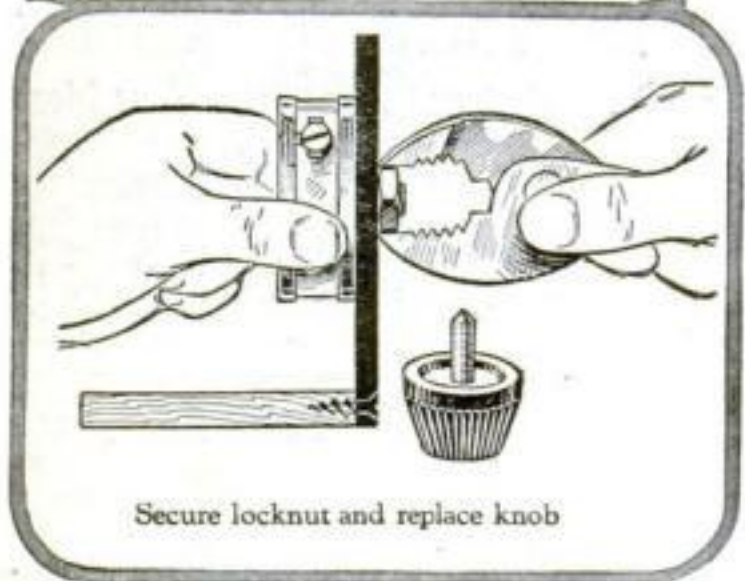
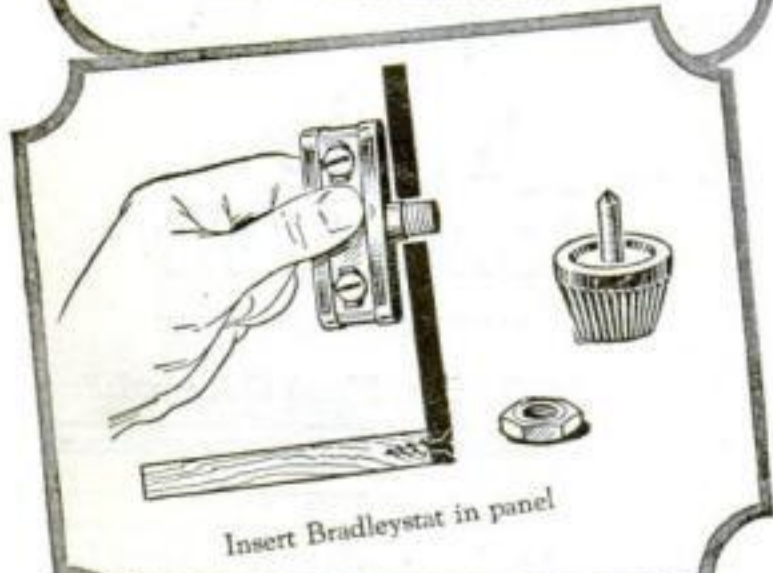
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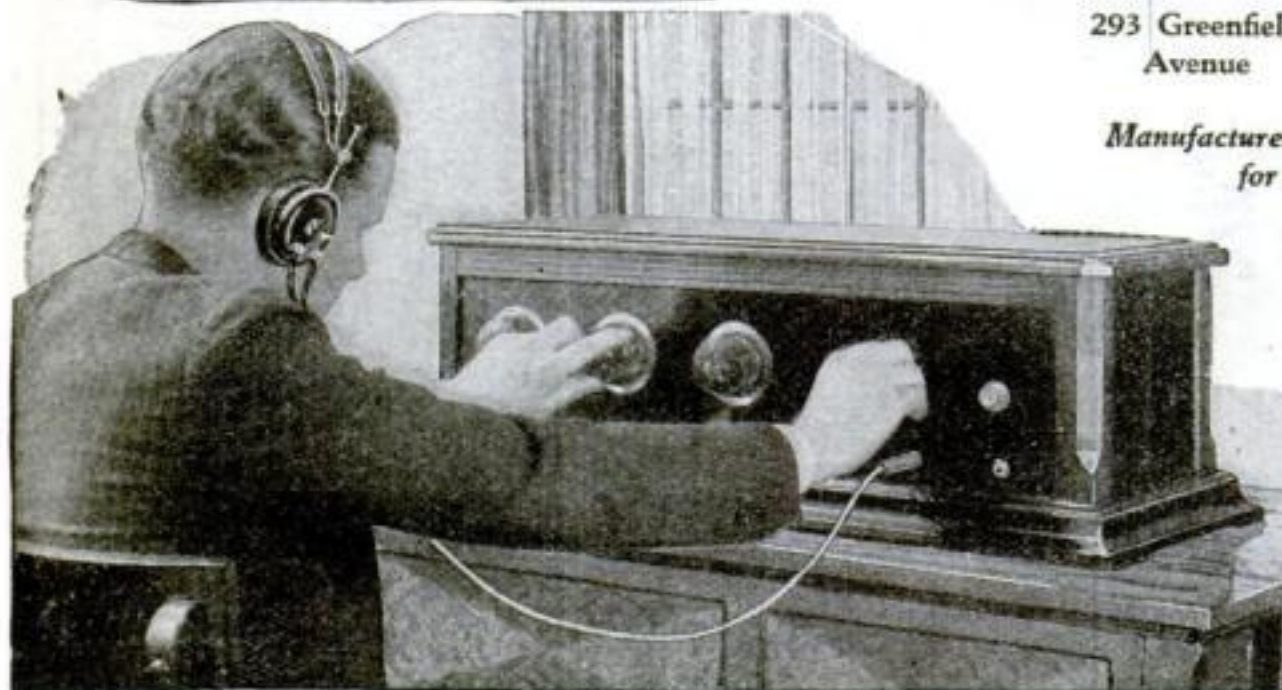
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